JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXV NO. 25 | SAN FRANCISCO, DECEMBER 18, 1915 | PER COPY, 25 CENTS

CALGARY'S ELECTRIC SUPPLY SYSTEM

DISCHARGE OF COLUMBIA RIVER AT THE DALLES
BY FRED F. HENSHAW.

DIESEL ENGINE PRACTICE.
BY. J. E. MEGSON AND H. S. JONES.

CONTROLLING THE WATER COLUMN IN HYDRO-ELECTRIC PLANTS
BY GEO. J. HENRY.

MATERIALS ADVERTISED IN THIS ISSUE

Batteries
Edison Storage Battery Co.

Boiler Feed Water Treatment
Dearborn Chemical Co.

Circuit Breakers
Westinghouse Elec. & Mfg. Co.

Christmas Suggestions
Pacific States Electric Co.

Conduit and Cable
Pierson, Roeding & Co.
Sprague Electric Co.

Diesel Engines
Busch-Sulzer Bros.-Diesel Eng. Co.

Heating Appliances
Simplex Electric Heating Co.
Pacific States Electric Co.

Insulators
Hemingray Glass Co.
Pierson, Roeding & Co.

Motors
Century Electric Co.
General Electric Co.

Piping
Pittsburg Piping & Equip. Co.

Transformers
Western Electric Co.

Transportation
Southern Pacific Co.
Northwestern Pacific Railway Co.

Turbines
Pelton Water Wheel Co.

Wire (Trolley)
"Phono," Pierson, Roeding & Co.

Wire and Cable
The Okonite Co.
Pierson, Roeding & Co.
Indiana Rubber Co.

Vacuum Cleaners
The Hurley Machine Co.

Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 7

—and now for the big

CHRISTMAS
HOLIDAY
SHOPPING
SEASON

It is becoming more and more electrical each year. This year more so than ever.

This is the time to fill your windows with

Electrical Christmas Suggestions

The toaster, percolator, samovar, iron, heating pad, curling iron, chafing dish and the numerous other articles—too many to mention here.

But you must anticipate your supply early to secure the articles desired as the holiday stock rapidly becomes limited as to variety on account of the heavy demands upon it.

Experience of past seasons has demonstrated that dealers with the greatest variety to select from have had most successful years.

Get in your order now; have the goods on hand early in the season that your customers may have time to see the articles and make up their minds as to the selection of gifts.

PACIFIC STATES ELECTRIC CO.

The Modern Electrical Supply House

Distributors for the Pacific Coast

LOS ANGELES
OAKLAND
PORTLAND
SAN FRANCISCO
SEATTLE

The

Thor

Electric

Vacuum Cleaner

Built for service, durability and increased sales.

A household necessity within the means of everyone. A wonderful seller. Write today for particalars and our latest catalog.

Hurley Machine Co.

Chicago New York

Distributors for the Pacific Coast

PACIFIC STATES ELECTRIC CO.

Los Angeles Oakland Portland
San Francisco Seattle

DEC 22 1915

©CLB344907

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXXV SAN FRANCISCO, DECEMBER 18, 1915 NUMBER 25

[COPYRIGHT 1915 BY TECHNICAL PUBLISHING COMPANY]

Bow River and Bow Lake.

CALGARY'S ELECTRIC SUPPLY SYSTEM

The City of Calgary in the Province of Alberta, Canada, is served with electric light and power by means of a municipally-owned system, hydroelectric power being purchased under a bulk contract from the Calgary Power Company which has two large generating stations on the Bow River, 58 miles from Calgary, to which power is transmitted at 55,000 volts. The power company also operates the city's 15,000 kw. steam plant as a stand-by unit. As this plan approaches what is believed to be the ideal solution of the question of municipal ownership, viz: private operation of municipally-owned plants with municipal distribution, a brief description of the system may be of interest.

The Watershed of The Bow River.

The Bow River has its source in the mountain lakes and streams and in the glaciers and snowfields of the Rocky Mountains. It drains an area of 3138 square miles on the eastern slope of the mountains immediately west of the city of Calgary, in the Province of Alberta. The waterfalls are numerous, as from its headwaters, 6500 ft. above the level of the sea, it falls 2750 ft. to Kananaskis Falls where the Kananaskis River joins the Bow, and from Kananaskis Falls to Calgary, a distance of 55 miles, a further drop of 720 ft. takes place. It is in this latter stretch that the most promising power sites exist and where the three Bow River developments at Eau Claire, Horseshoe Falls and Kananaskis Falls are situated.

Above Kananaskis Falls the entire drainage area of 1710 square miles lies wholly within the Rocky Mountains National Park of Canada. The flow of the river, as in all mountain streams of this character, is subject to sudden variation and is greatly influenced by conditions of temperature. During the winter months the flow is held in check, but in the hot summer months of June and July the melting winter snows and the glaciers loose their floods which rush through the mountain gorges to the Bow, down the Bow to the Saskatchewan and to Lake Winnipeg, then down the Nelson to the sea. The summer floods are very great compared with the winter flow, a flood of 45,000 cu. ft. per second being measured on the Bow River just above the confluence of the Kananaskis while a low water flow of 500 cu. ft. per second has been measured at the same point.

From Bow Lake, the source of the river, down to Laggan, the river flows for the most part through a wide valley in the midst of towering mountains. Below Laggan, as far as Kananaskis Falls, the valley traversed is wide, flat and covered with gravel, and the stream is tortuous in its course. In two or three places in the main valley above Banff small lakes occur, probably formed by the damming off of part of the old river course by the material carried down from the surrounding mountains. Below Banff, near Exshaw, the river widens out and covers the greater part of the valley. At Kananaskis Falls an abrupt change in the topography of the country takes place, due to the fact that the river leaves the mountains proper and flows out into the foothills, these conditions continuing as far as Calgary.

For the purposes of description the Bow River above Calgary may be conveniently considered as of

two economic portions, that above Kananaskis Falls being a storage section, and that below the power section.

From Kananaskis Falls, nearly to Calgary, the river flows through a wide valley for long stretches; the river proper is confined, however, to its channel by steep banks that at different points are rocky cliffs of considerable heights running as high as from one hundred to one hundred and fifty feet. Generally these cut banks have long sloping banks opposite to them,

Minnewanka Dam near Banff.

but in places the river channel is canyonlike for short stretches and is thus readily adaptable to power development works.

The storage section of the river, a stretch of approximately 90 miles in length, lies to the west of Kananaskis Falls, and entirely in the mountains. Nearly all the streams flowing into the Bow River have, at or near their source, a lake of greater or less size. The larger lakes include the Bow and Hector lakes at the highest elevations; Lake Minnewanka, near Banff, at the head of Cascade River; the Spray Lakes at the head of the Spray River; and at the headwaters of the Kananaskis River, Kananaskis Lake. Other lakes, many far famed for their scenic beauty, which are extremely valuable for their regulating effect, but not so suitable as controlled storage basins, include Lake Louise at Laggan; Ptarmigan, Baker and Redoubt Lakes; Moraine Lake, in the valley of the Ten Peaks; and Boom Lake and Shadow Lake. All feasible storage on the Bow River above Calgary is fortunately available for the whole water stretch of the river. The mean flow for the winter months has been 720 cu. ft. per second, but by means of the storage that has been, and may be created, it is anticipated that the mean flow can be increased to about 1500 cu. ft. per second.

Horse Shoe Falls Plant.

The Horse Shoe plant of the Calgary Power Company is at Horse Shoe Falls, 50 miles west of Calgary, where a natural fall of some 25 ft. has been augmented by a concrete dam to give a 70 ft. head. The dam is of solid spillway type with an inspection and drainage tunnel. In addition to this spillway there are a number of sluiceways provided to take care of flood discharges. Inspection tunnel, access to which is gained by means of a well between the flood discharge openings, extends under the spillway section into the rock at the west abutment of the dam. Four penstocks are installed leading from the intake to the power house which is situated in the gorge below.

The complete power equipment consists of four turbines, two being of 3750 h.p. capacity and two being of 6000 h.p. capacity each. The electric generators are direct connected and produce their power at 12,000 volts, this being stepped up by transformers to 55,000 volts for transmission to Calgary. A portion of the power is transmitted to Exshaw for use in cement mills direct at the generator voltage of 12,000 volts.

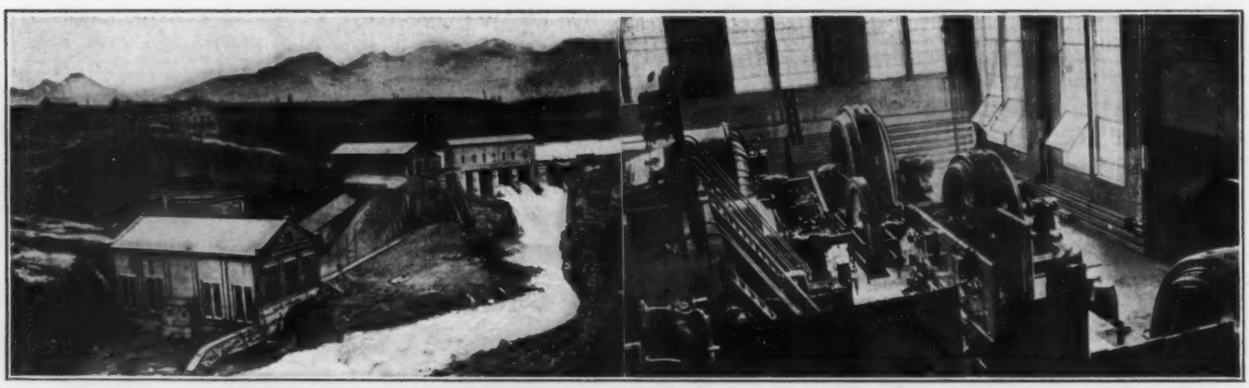
The transmission lines, in duplicate, are of aluminum cable on wooden poles.

Kananaskis Falls Plant.

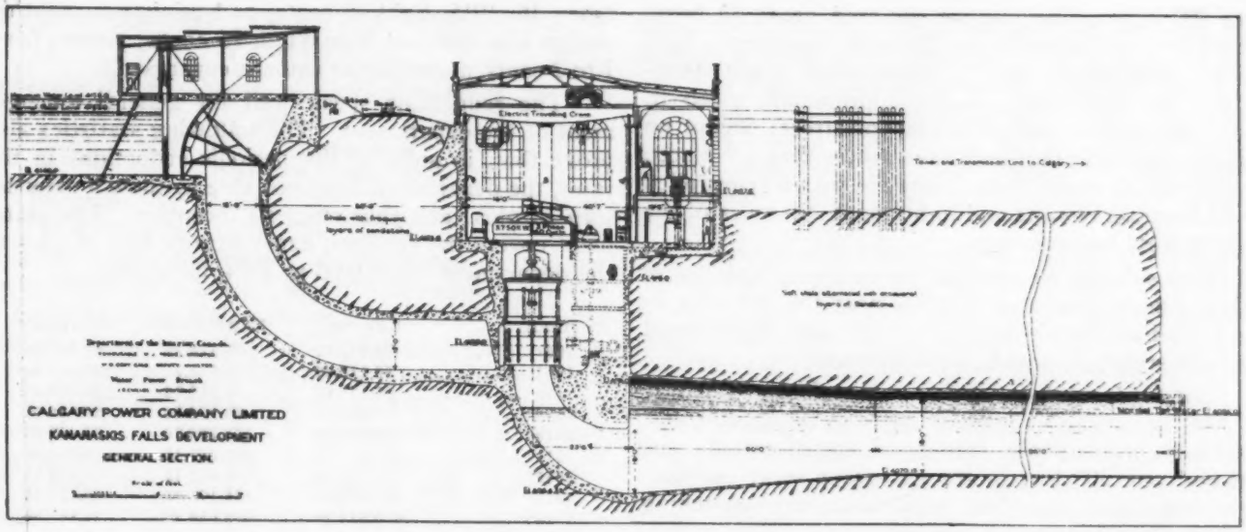
The site of this plant is at the Kananaskis Falls, immediately below the junction of the Kananaskis and Bow Rivers, and about two miles above the Horseshoe Falls.

The head is composed of rapids and a series of three falls, giving a total drop of approximately 55 ft. Above the rapids, the Bow is wide and fairly shallow, while the banks are comparatively low, but gradually increasing in height to the head of the falls. Below the falls the banks are perpendicular, the river flowing through a rather wide canyon. The banks of the Kananaskis are high, the west bank being perpendicular and rising at least 40 ft. above the surface of the stream; the slope of the east bank is more gradual for the first few hundred yards, but after that it is high and abrupt.

The development adopted includes a dam placed across the head of the falls, raising the water and



Calgary Power Company's Horse Shoe Falls Plant.



Kananaskis Falls Development.

diverting it into a canal excavated on the south side of the river, which conveys it to the intake. The water from the intake is conveyed in tunnels to the turbines in the power station. The turbines are of single runner type, with vertical shaft, and utilize the created head of 70 ft.

The turbines are at present two in number, each of 5800 h.p. capacity, direct connected to a generator. The voltages of 12,000 on the generator and 55,000

Kananaskis Dam.

volts on the transmission line correspond to the characteristics of the electrical output of the Horseshoe Falls plant to which it may be connected to operate in parallel, the two plants being owned and operated by the same company to serve the same markets.

The load contracted for in bulk has rapidly increased, the initial contracts being 5500 h.p. in 1911 and increasing to 13,000 in 1914, a rate of growth which fairly well seems to be established for power plants supplying Canadian cities.

From an engineering point of view one feature common to both these developments is very interesting. After unwatering the sites and examining the foundations, the seams in the stratified formation were suspected of providing a means of excessive leakage, and to obviate any such occurrence, a series of three inch holes were drilled 10 ft. apart, immediately in front of the respective dams to a depth of 40 ft. Into these holes was poured a grout mixture of cement, and the seams spreading from the holes were effectually filled and the foundation rendered impervious.

Distribution System.

The distribution lines include over 20 miles of overhead 3-phase No. 00 copper wire and 23,635 ft. of No. 00 12,000-volt, 3-phase, paper-insulated, lead-covered, underground cable; the overhead line is carried on a graded 45 ft. lead, also the necessary cross arms, insulators, pole-top switches, etc.

The overhead lines interconnect the Calgary Power Company's substation with the city substation through a one circuit line, and also connect the power company's substation with the city's generating station through two separate 3-phase lines, also one loop line 14 miles in length.

The underground cable of this system interconnects the generating station and the city's new substation through two separate 3-phase cables, each cable

Kananaskis Falls, Bow River.

being of sufficient capacity for the station, so that in case of trouble on either cable the other is capable of carrying the load while repairs are being carried out.

The current is distributed throughout the city over fifteen 2300-volt, 3-phase circuits ranging in size from 1-0 to 300,000 circular mills. Underground feeder cables are used to supply the current to the center of distribution of the most important lighting circuits, with the object of making the source of supply as reliable as possible. The 2300-volt system consists of 233 miles of pole line.

From the transformers the current is distributed to the customers over secondary feeders, which are mostly single-phase, 3-wire, 110 and 220 volts for lighting, and 3-phase, 220 volts for power.

The department has in service 14,130 meters ranging in capacity from 5 to 200 amperes.

Street Lighting—Substations—Organization.

The street lighting consists of over 1600 lights, of which 830 are magnetite arcs ornamental and pend-

ant; 200 alternating current inclosed arcs; 40 flame arcs; four hundred and forty 250-watt 6.6-ampere high efficiency tungstens; and 113 ornamental 5-light standards. The lights are placed approximately 566 ft. apart on avenues and 46 ft. apart on streets, except on principal business thoroughfares, where they are placed at intervals of about 90 ft. They are fed and controlled by 25 separate circuits and light about 200 miles of the city's streets and avenues.

Two substations were contructed and equipped in 1912. One is located at Ogden, near the entrance to the Canadian Pacific Railroad shops, and the other at Seventh street west and Ninth avenue.

The Ogden substation has a transformer capacity of 3000 kw. The equipment consists of six 500 kw., 1200-volt, single-phase step-down transformers; one 500 and one 300 kw. motor generator sets; one arc-light regulator, together with necessary switching equipment and control apparatus.

The Ninth avenue and Seventh street west substation has a transforming capacity of 6000 k.v.a. and direct current generating capacity of 2000 kw. The equipment consists of two 3000 k.v.a., 3-phase, 12,000-volt transformers and two 1000 kw. motor-generator sets, 7 arc-light regulators, and also the necessary automatic voltage regulators, switching equipment, etc.

During 1912 the department was rigorously reorganized by the city electrical engineer, who appointed competent officers to take charge of each important branch of the department, these officers being held entirely responsible for the efficient execution of all matters under their jurisdiction.

A clerk of works was delegated to keep a record of all time and material on each job and file a copy of same in the office, so that it is always available for reference.

Plans have been made of the distributing system, showing all primary lines and location of transformers; a complete filing-record system has been installed, wherein is kept all data concerning the load and general characteristics of each transformer, together with a plan of the secondary circuit to which the transformer is connected.

Another important feature is a meter filing record card system, which shows the meter location, a curve showing its accuracy, when last tested, and also the capacity, reading, and date meter was set and first put into service.

The city plant began operations in December, 1905, with a lighting rate of 14 cents per kilowatt hour and power rate of 10 cents per kilowatt hour. By-laws have since been passed readjusting rates per kilowatt hour, as follows:

December 20, 1907, light, 14 cents; power, 10 cents. August 24, 1908, light, 12 cents; power, 7 cents. April 13, 1909, light, 11 cents; power, 6 cents. May, 1911, light, 9 cents; power, from 1 to 2 cents, according to amount consumed; this reduction was made when the department was first supplied with hydroelectric power. August 5, 1912, light 7½ cents; power from 1 to 2 cents, according to amount consumed. February 16, 1915, light, 5 cents, and minimum monthly charge also reduced from $1 to 75 cents; power, from 1 to 2 cents, according to amount consumed.

The reductions speak well for general management of the department. The following statistics also prove that, in spite of the periodic reductions in the rates, the department has been able to show a satisfactory surplus each year since its inception. The statement covers the receipts, expenditures, and surplus of the department from 1906 to 1914, inclusive:

Year.	Revenue.	Expenditure.	Surplus.
1907	58,172.67	35,878.37	22,294.30
1907	58,172.67	35,878.87	22,294.30
1908	85,172.67	58,777.70	26,782.95
1908	85,560.65	58,777.84	26,782.95
1910	193,099.82	170,692.50	22,407.32
1911	206,227.95	202,247.48	3,890.47
1912	384,173.32	366,382.41	17,790.91
1913	544,348.40	445.177.09	99,171.31
1914.	670,512.24	592,654.28	77,857.96

This department has paid all its debenture interest and sinking fund and in addition has a depreciation reserve account, which totaled $178,922.78 at December 31, 1914.

The data for this article have been taken from the publication of the Dominion Water Power Branch, Canadian Department of the Interior, and from a report of the United States Department of Commerce.

The "St. Paul" electrification between Three Forks and Deer Lodge, Montana, was given a preliminary try-out this week. Following the run over this 113-mile division, complete electric operation will be started. President Earling and C. A. Goodnow, assistant to the president in direct charge of electrification, accompanied by a staff of railroad officials and representatives of the General Electric Co., were present at the beginning of electric operation. The Chicago, Milwaukee & St. Paul Railway Co. contemplates in the future the extension of this work to the Pacific Coast which will make a total of 850 miles of continuous electric travel. This enterprise has been undertaken on purely economic grounds, with the expectation that superior operating results with electric locomotives will effect a sufficient reduction on the present cost of steam operation to make the investment pay for itself within five years. It is impossible, however, to draw any general conclusions from this statement in view of the fact that water power is utilized upon this railroad and that the question of the cost of coal is one that enters in very different degrees in the case of different roads. It is probable, however, that so large an experiment in the substitution of electricity for steam will prove a great stimulus toward the introduction of similar improvements throughout our railroad system. Such advances as that of the electrification of the great steam railroads, and still more such spectacular achievements as those recently recorded in telephony, both wireless and over the wires, suggest the initiative and variety and energy of effort of private enterprise.

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

Appendix B—Discharge of Columbia River at The Dalles.

BY FRED F. HENSHAW,
District Engineer U. S. Geological Survey.

Location of Station. At The Dalles, Wasco County, Oregon, in Section 34, T. 2 N., R. 13 E., about 18 miles below the mouth of Deschutes River, and above Hood and Klickitat Rivers. This point is about 90 miles by river above the mouth of the Willamette near Portland, and about 187 miles above the mouth of the Columbia. The drainage area above The Dalles is 237,000 square miles, of essentially arid country, surrounded and interspersed by high timbered mountain ranges, from which the river derives practically all its runoff. Within 40 miles below The Dalles, the Columbia enters the humid area which lies between the Cascade Mountains and the sea. The area drained below The Dalles is 32,000 square miles, the total of the basin at the mouth 259,000 square miles.

Gages. Gage records used as follows: Oregon Steam Navigation Company gage at Lower Cascades Landing during high water periods 1858 to 1877; U. S. Engineer gage at Umatilla June 1 to December 6, 1878; U. S. Engineer and Weather Bureau gages at The Dalles, October 10, 1879, to June 30, 1881, and February 1, 1893, to September 30, 1910; U. S. Engineer gage above the Cascades, December 12, 1878, to 1893, and for gaps in record at The Dalles thereafter.

The standard gage from which records have been used as far as available, is the gage of the United States Weather Bureau at The Dalles, locally known as the Brooks gage. This is made up of several sections attached to piling of the viaduct connecting the "Regulator" dock to the warehouse of The Dalles, Portland and Astoria Navigation Company. The datum of this gage is 46.36 ft. above sea level, and 57.33 ft. below the U. S. Geological Survey iron post bench mark near the southeast corner of the Wasco County courthouse, the elevation of which, according to the 1912 adjustment of the primary level net, is 103.694 ft. This gage has been occasionally washed out and replaced. No records are available of the gage having been checked, but it is believed that it was checked up occasionally by the U. S. Engineers. The gage was found to be correct in August, 1914.

The U. S. Engineer gage is similar, but is referred to the assumed datum plane of The Dalles-Celilo Canal, which is 8.9 ft. lower. The readings made 1879 to 1881 were made on a number of gages set at arbitrary datums; the readings were all reduced to the U. S. Engineer datum, and have been in turn reduced to the datum of the Brooks gage for this report.

The gage above the Cascades, at Cascade Locks, has been located at different points. Most of the time prior to December 31, 1900, the gage was attached to a wharf. On or about January 1, 1901, readings were commenced on the present gage, which is attached to the side of wooden fender of upper locks chamber, between upper guard and lock gates. In its present position it records the height of water accurately, except when ice is running. Ice has a tendency to collect at the upper entrance of the canal, and in the canal itself. In extreme conditions this ice may jam so as to prevent a free access of water to the gage.

The gage at Lower Cascades Landing, designated as No. 13, of a series of gages used by the U. S. Engineers, is located at the lower end of the old Oregon Steam Navigation Company portage railway above Bonneville, which is above the upper limit of tide effect.

Readings at Umatilla, about 100 miles above The Dalles, and at the lower end of the canal at Cascade Locks, have also been used or studied in the interpretation of the data.

Channel. Columbia River through most of its course across United States territory flows in a rock-bound channel through a solid volcanic formation. The section of the stream where it breaks across the Cascade Range, between Cascade Locks and Bonneville, Oregon, is in a relatively narrow canyon. The section between the Cascades and The Dalles, about 40 miles upstream, is wide and deep, the flow is more sluggish, and the bottom is overlaid with sand and silt. There may be minor changes in channel configuration in this portion, but the reef at the Cascades acts as an effective control, and the relation of the gage height to discharge at The Dalles appears to be practically permanent.

Discharge Measurements. Float and meter measurements were made by the U. S. Engineer Corps at Cayuse Rock, 7 miles below The Dalles, in 1903. The floats were long rods, weighted to float in an upright position, reaching from the surface to as near the bed of the river as practicable. The meter measurements were made from a boat anchored on a range line. The measurement by the United States Geological Survey in 1907 was made about 3000 ft. below the ferry at The Dalles. A large Price current meter held on a piano wire was used. A small cable was thrown across the channel, fastened at the water's edge on each bank, and allowed to sag below the surface just sufficient to permit the passage of steamers. The cable was tagged at 10-foot intervals and used to hold a small boat, from which the meter was operated. In this manner it was possible to take velocities at all points in the vertical, although depths of 90 ft. were encountered. A reeling device was used to measure depths, whereby the position of the meter below the surface at all times was indicated by a dial. Velocities ranged from 0.4 to 3.4 ft. per second. Vertical velocity curves were taken about every 100 ft. in width. These indicated that a coefficient of 1.05 should be used to reduce velocities observed at 1 ft. depth to the mean in the vertical. The applicability of coefficients derived from these curves to changed conditions is subject to much uncertainty. It is reasonable to suspect that with the low velocities observed, the surface current may have been retarded somewhat by an upstream wind.

Float measurements were made during the spring flood of 1908, over a 1000 ft. range at the same section as the measurement of the previous October. The floats used were weighted rods, 5 ft. in length. The points where they crossed the range lines were determined by a transit. A coefficient of 1.05, as determined from the earlier low water measurement, was

originally used to reduce the surface velocities to the mean in the vertical. Studies of vertical curves were made under conditions more nearly approaching those which obtained when the two measurements were made, especially with respect to the mean velocity, indicate that 0.92 would give more nearly correct results, and this has been used in recomputing the measurements.

In 1913, in connection with the investigation of which the present report is the result, it appeared that additional high water measurements should be made. It was decided to use the railroad bridge near Pasco, Washington, as offering the only feasible equipment for meter measurements short of an expensive cable installation. The bridge of the "North Coast" line of the Oregon-Washington Railroad and Navigation Company across the Columbia below the mouth of the Snake did not offer favorable condition on account of extremely high velocities and disturbance at the frequent piers. The two bridges of the Northern Pacific Railway across the rivers above their junction presented fairly favorable conditions. The Columbia is over 2500 ft. wide at flood stage, and barely 40 ft. deep; the Snake about 1300 ft. wide, and, on an average, shallower. Only surface velocities were obtained in the first measurement at the crest of the flood. A second measurement was made about a month later when the stage had fallen about 10 ft. A small Price meter was used on a simple reel, using a single bare wire and 40 lb. of lead weight. With this equipment velocities were obtained down to within 5 ft. or less of the bottom, although depth could not be determined accurately at that time. A coefficient of 0.90 for reducing surface observations to mean velocities in the vertical, as determined from those observations, was applied to the previous measurement. The discharge of Snake, Umatilla, John Day, and Deschutes Rivers, as computed from gage readings at stations near their mouths, have been added to the measured discharge of the Columbia at Pasco to give the flow past The Dalles. The gage reading at The Dalles for a day later than the measurement was made have been used, allowing this length of time for the water to pass between the two points.

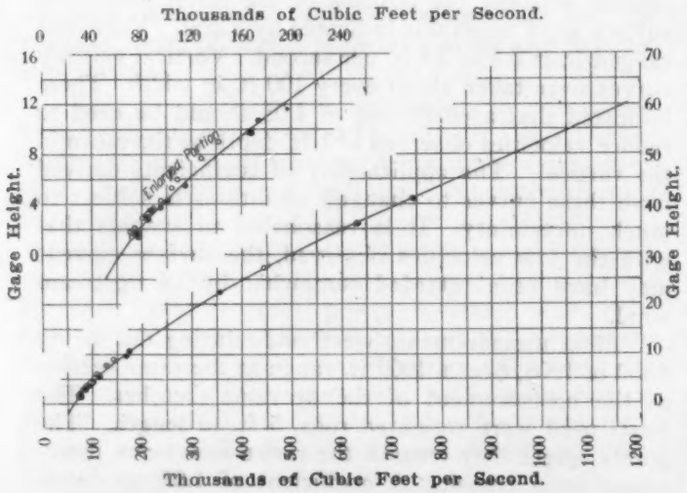


Fig. 12. Discharge Measurements and Rating Curve of the Columbia River at The Dalles.

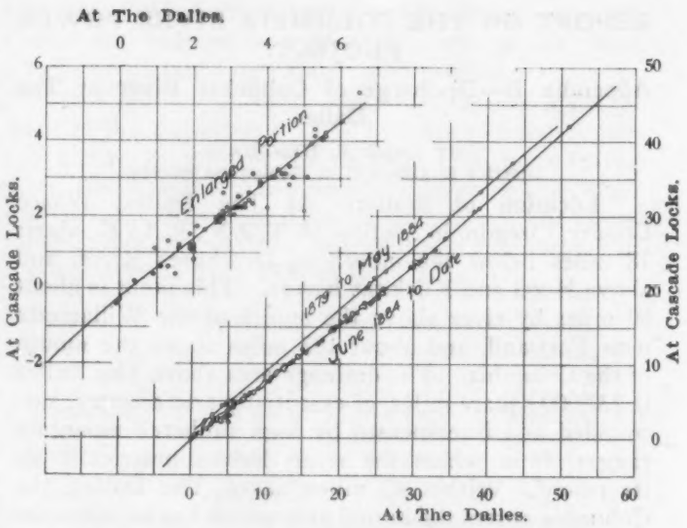


Fig. 13. Relation Curves Between Gages at The Dalles and at Cascade Locks.

The low water measurements made above Snake River in 1910 and 1913 have been used in a similar manner to define the curve for The Dalles.

Rating. The rating curve adopted for the revised computations (shown in Fig. 12) has been drawn through the two flood measurements of 1913, close to the two float measurements of 1908, as recomputed, and the three meter measurements made at low water in 1907, 1910 and 1913. It averages the nine meter measurements made in 1903, but is about 5 per cent larger than the average of the float measurements of that year. No study has been made by the Geological Survey of the measurements in 1903, but it is believed that the meter measurements give better results. The curve is well defined above a discharge of about 70,000 sec. ft.; for lower discharges it is somewhat uncertain, due to lack of measurements at extreme low stages.

The ratings for Cascade Locks and Umatilla have been derived from that at The Dalles by a comparison of the gage readings. The monthly mean gage heights for the two stations have been plotted as co-ordinates and a relation curve drawn similar to a rating curve (see Fig. 13). The relation curve for The Dalles and Cascade Locks for 1894 to 1914 is well defined above a gage height —0.5 ft. on Cascade Locks gage. The plotted points from 1892 up to the extreme flood of 1894 plot a little higher with respect to Cascade Locks, but the uncertainty thus introduced is only 3 or 4 per cent at low stage and negligible at higher stages. The relation curve defined by plotted points for 1879 to 1881 plots higher than the later curve by amounts varying from 1.1 ft. at 1.0 ft. stage to 2.3 ft. at 20 ft. stage at Cascade Locks.

In order to decide at which station the change had probably occurred, comparative plots were made of monthly mean gage heights, as follows: Cascade Locks with Umatilla, Cascade Locks with Celilo, Cascade Locks with Lower Cascades Landing, and The Dalles with Umatilla. The latter comparison, although only fairly defined, indicates permanency of relative conditions between these two stations between the two periods 1879 to 1881, and 1901 to 1904. The comparisons of the other stations with Cascade Locks show

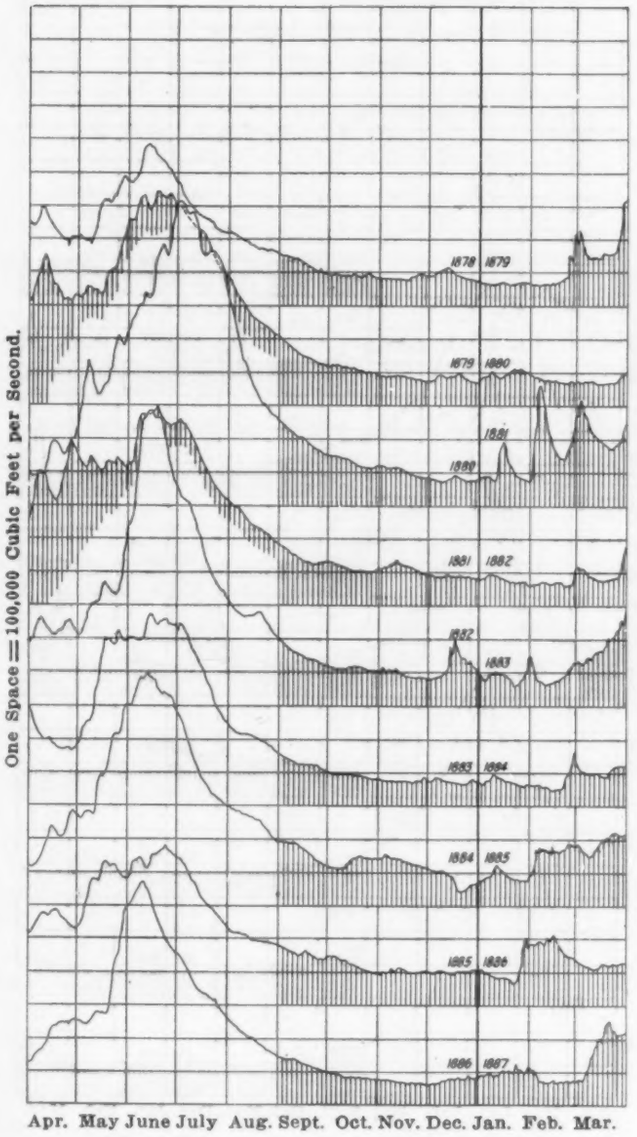


Fig. 14. Hydrographs for Years 1878 to 1887.

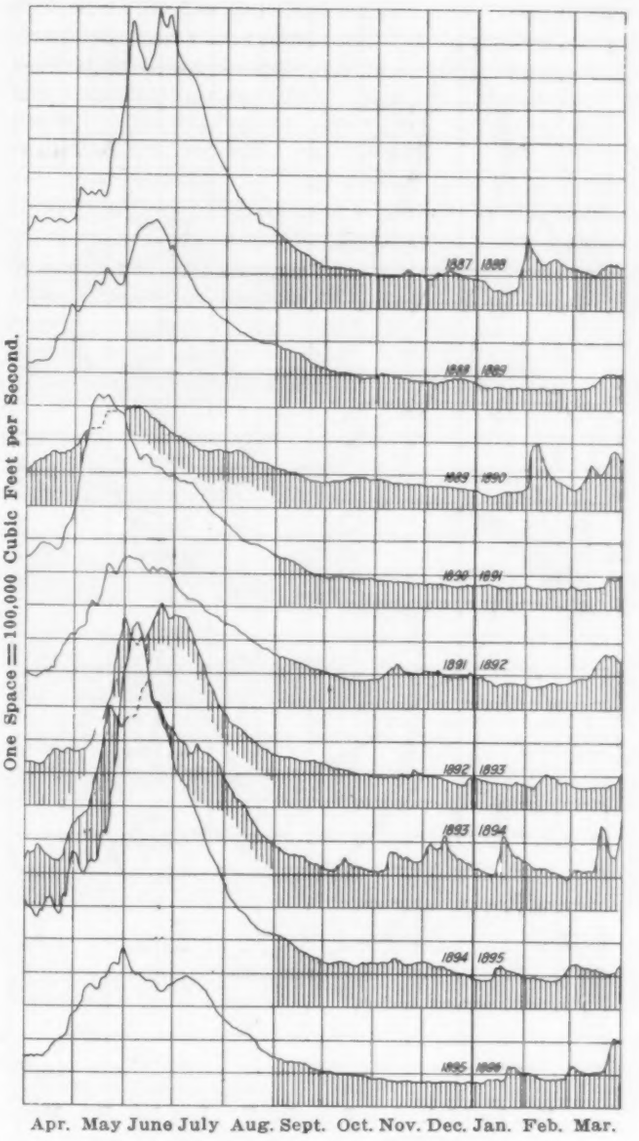


Fig. 15. Hydrographs for Years 1887 to 1896.

changes between the early 80's and later years, as follows:

Changes with Respect to Cascade Locks in Relations Between Readings at Cascade Locks and Other Stations on Columbia River.

	Stage at Cascade Locks.			
Cascade Locks, and	1.0	5.0	20.0	35.00
Umatilla	0.6	.8	1.4	2.3
Celilo	1.5	1.9	3.2	3.3
The Dalles	1.1	1.2	2.3	2.0
Lower Cascade Landing	1.1	1.2	1.5	1.8
Adopted difference	1.0	1.2	2.0	2.0

Of the four gages with which Cascade Locks may be compared, only two, Umatilla and Lower Cascades, were read between June 30, 1881 and 1892. The break from the earlier to the later curve occurs as nearly as can be determined in both cases on June 1, 1884, and the change of rating for Cascade Locks has accordingly been made on that date. The cause of the change is problematical as the gage was apparently carefully maintained at its proper datum. The following note appears in the Annual Report of the Chief of Engineers, 1880, p. 2304, referring to the Cascades:

"The enlargement of the high water channel * * * consisted of leveling down conglomerate masses and boulders, and cutting away the face of a ridge below the embankment."

This embankment extended from the head of the canal to station 20. This probably accounts for the fact that the change was about 2 ft. at high stages and only 1 ft. at low stages. This relative change in flood rating probably did not occur all at once, or at the same time as the general shift of relation curve, but no great error is introduced by assuming that both changes took place at the same time.

The rating for the flood stage heights at Lower Cascades Landing has been derived from that for Cascade Locks for 1879 to 1884, by means of a curve of relation for the same period. As the high water discharges of 1862 and 1876 are checked quite closely by high water marks at The Dalles and Cascade Locks, it is believed that the value given for the floods of the earlier years is not materially in error.

Accuracy. The rating for The Dalles is probably within 5 per cent for discharges between 80,000 and 900,000 second feet. The curves of relation between

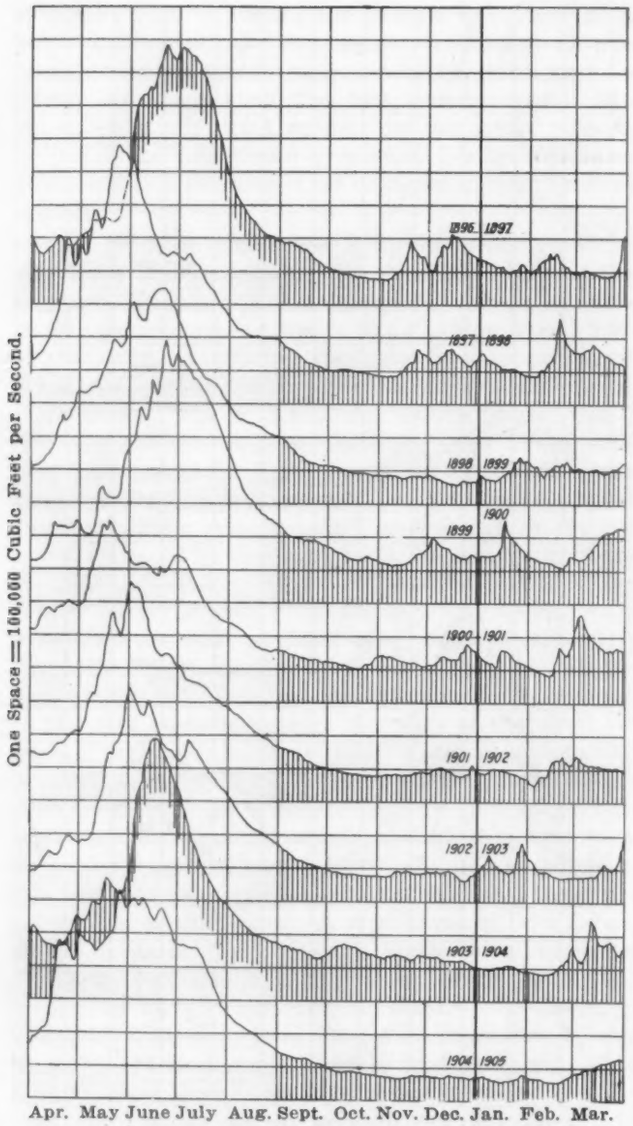


Fig. 16. Hydrographs for Years 1896 to 1905.

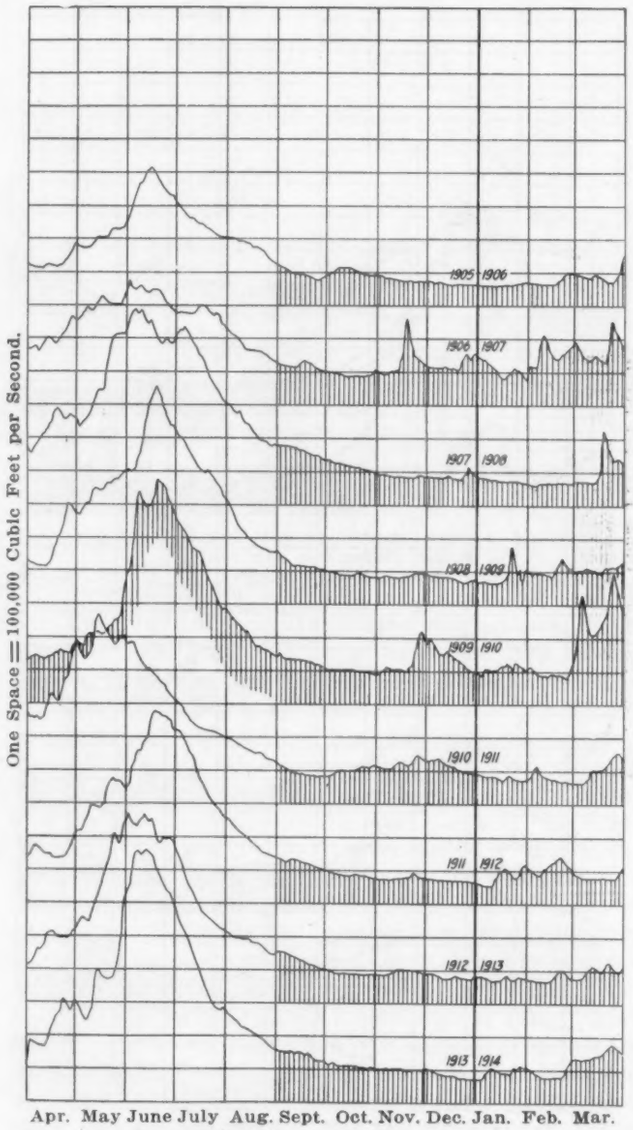


Fig. 17. Hydrographs for Years 1905 to 1914.

The Dalles and Cascade Locks are so well defined that only a slightly lower degree of accuracy may be attributed to the discharges based on Cascade Locks gage heights from January 1884 to date. There is a considerable amount of inflow from the 2600 square miles of drainage area tributary to Columbia River between The Dalles and the Cascades, but it constitutes a relatively small percentage of the total flow of the river. The effect of any variation in the rate of inflow is apparently within the limits of accuracy of the results as a whole. Gaging stations have been maintained on the three principal streams, Klickitat, Hood and White Salmon Rivers, near their mouths. The runoff from an area of 1640 out of 2600 square miles was determined for the two calendar years 1910 and 1911, and that for the balance of the area has been estimated. The mean inflow by months and the percentage which it bears to the flow at The Dalles is shown by the following table.

Estimated Inflow in Second Feet to Columbia River Between The Dalles and Cascade Locks, 1910-1911.

Month.	Inflow between The Dalles and Cascades, sec. ft.	Per cent of Columbia at The Dalles.
October	2,200	2.4
November	4,200	4.2
December	4,000	4.4
January	5,400	5.8
February	4,800	5.6
March	9,200	4.9
April	7,400	3.0
May	7,200	1.8
June	5,400	1.2
July	3,300	1.1
August	2,500	1.4
September	2,400	2.2
The year	4,830	2.5

Monthly means for 1884 to date based on readings at Cascade Locks are believed to be within 5 per cent (A) above 100,000 second feet, and within 10 per cent (B) below this, except for two months of extreme low water. Owing to uncertainties of just when and how the change in the early 80's occurred, all records prior to July, 1884, are "B." The discharges derived from Umatilla readings in 1878 are liable to more error, due to inflow below the gage, and are rated as "C" (probably within 15 per cent).

(To be continued.)

An electric cable between Denmark and Sweden is transmitting electric power for industrial purposes, the operating potential being 40,000 volts.

CONTROLLING THE WATER COLUMN IN HYDROELECTRIC PLANTS.

BY GEO. J. HENRY.

(This article is one of a series that has been published from time to time regarding the construction and design of hydraulic apparatus. Each installment is complete in itself, this describing the method employed to automatically counter balance the hydraulic thrust in high head Francis turbines. Next week details will be published of the design of a suitable relief valve for Francis turbines. The author is a consulting hydraulic engineer at San Francisco.—The Editor.)

There is probably no single factor whose careful study is more important to the success of an hydraulic power plant than the velocity and inertia of the water column.

The retardation of the velocity of the moving water column even to a very small degree is accompanied by the expenditure of a very large amount of energy, which if not permitted through safe channels, will invariably be accompanied by abnormal and therefore damaging stresses, if not the rupture of the pipe or pressure connections thereto. Such stresses may generally be considered to increase as the length of the pipe and as the difference in the velocity squares before and after the change.

It is usually desirable to use only that quantity of water necessary to develop the required power at any instant of time and as in all plants the load is usually undergoing changes, and these are frequently of great rapidity, the inertia effects of the water become all important.

If it be attempted to govern the plant by opening and closing the water gates supplying water to the runner, either the gate movements must be made slow, in which case the speed changes from normal will be greater while the gate movement is being made, or else some suitable control of the water column must be made independent of the water gate movement to prevent damage from the water inertia.

The treatment of this matter falls more directly under the head of the governor control, as it is because of the governor requirements that it must be dealt with. But it may be generally stated that in plants where the water column velocity is varied, there are varying stresses in the water conduit, and especially in and about curves therein. This is of course true af all the elbows and angles in the main pipe at which

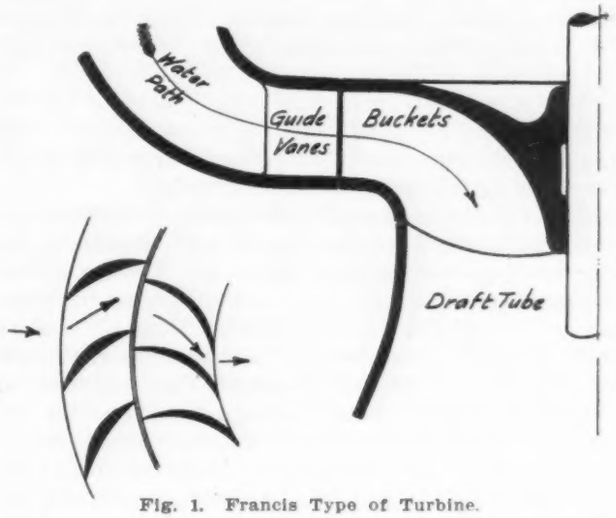


Fig. 1. Francis Type of Turbine.

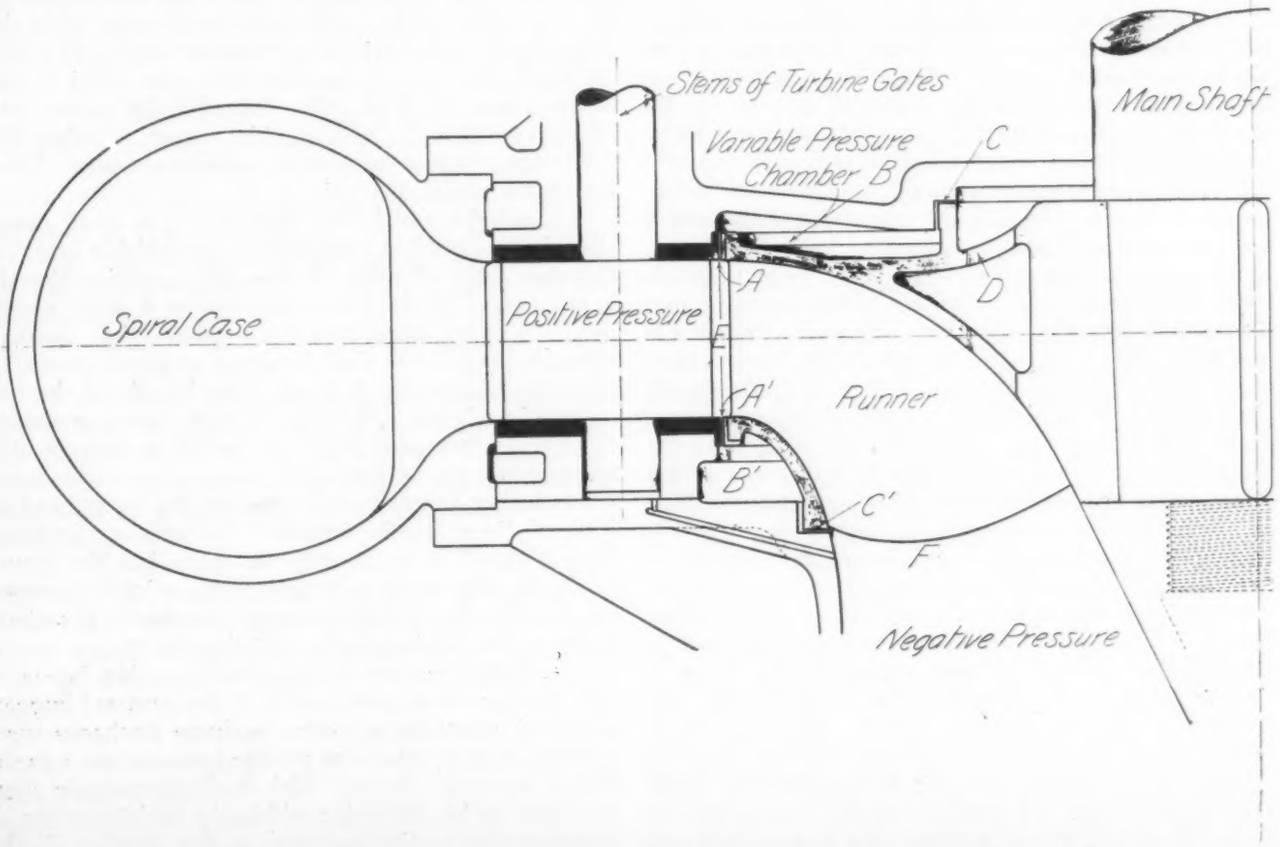


Fig. 2. Variable Hydraulic Counter Balance Applied to Runners in I. P. Morris Francis Turbine.

velocity pressures must be carefully considered and taken care of by suitable strength and anchorage, but far more important does the problem of velocity change become where we have curves in the water flow within the running parts of the turbine wheel, especially of the Francis type, as shown in Fig. 1.

By referring to Fig. 2 it will be clear that the water moving over the curved interior surface of the runner, will, due to its velocity pressure, tend to force the runner upward or away from the draft tube, and as the velocity or quantity of the water moving within the runner changes due to the movement of the gates to compensate for load changes this pressure will vary —also that the draft tending to draw the runner downward will vary but slightly if at all; we will therefore have a variable thrust against the runner which must be carefully studied and provided for if successful operation is to be attained.

It is probably true that were it not for the hydraulic balancing of this variable pressure, turbines of the Francis type would have been impossible in the large and high head installations of today.

Fig. 2 shows the variable hydraulic counter balance applied to the runner in the turbine units at the Big Bend power house of the Great Western Power Company near Oroville and is a diagrammatic cross section through the runners of the No. 5 and No. 6 units, each of 18,500 h.p. capacity, as built by the I. P. Morris Company of Philadelphia, and Fig. 3 shows the variable hydraulic counter balance applied to the 20,000 h.p. rated capacity Francis turbine unit of the Pacific Gas & Electric Company, as built by the Pelton Water Wheel Company of San Francisco and recently exhibited at the Panama-Pacific Exposition.

It will be obvious from an inspection of Fig. 2 that if the casing and runner be full of stillwater under full static pressure, that leakage through the joints between the runner and casing at **A A′** will quickly fill the chambers **B** and **B′** and there will be no tendency to move the runner exerted by the water, as pressure will have equalized all around it. If now the water be set in motion through the runner we will have a high pressure at **E** and a negative or vacuum pressure at **F**, and a pressure that is reducing from the high to the vacuum during its passage through the runner. There will therefore be within the compartments **B** and **B′** the full pressure **E** and due to the reduced pressure within the runner there will be a tendency for the runner to move upward. Upon its slightest movement upward, however, water will be checked by the plug or piston **C** causing an increase of pressure within **B** and hence the re-establishment of equilibrium. That is, the runner will move when a variation in water column velocity occurs, until a sufficient flow occurs by the flange **C** to cause the necessary reduction or increase of pressure within the variable pressure chamber **B** to compensate for the pressure variation within the runner; the leakage that occurs by the flange **C** finding ready discharge within the runner through the holes **D** at reduced pressure points. The chamber **B′** is not always used but may be when desired and then invariably acts in parallel with **B**, the pressure building upon one side and reducing on the other wherever a movement of the runner takes place in an axial direction due to any unbalanced condition. The weight of the entire rotating element, as well as the water pressures, is to be taken into account in vertical shaft Francis turbines, and it is to be noted that the leakage area by **A A′** is not to vary or at least not to as great an extent as does that at **C C′**. The pressure within the varying pressure chamber or chambers may obviously vary from almost full running pressure at **E** to that shown by the vacuum gauge and in the case of the 18,500 h.p. Great Western runners the upper variable pressure chamber has an area of about 2540 sq. in. which under the working head corresponds with from 0 to 300,000 lb. upward thrust available upon the runner to effect automatic balance and when operating therefore with a properly designed variable pressure chamber there is automatically maintained a counterbalance of hydraulic pressure relieving the step bearings of any heavy load, the action is entirely automatic and the vertical movement necessary need not exceed 1-8 or 3-16 of an inch or less, even in runners of great size.

In units Nos. 1, 2, 3 and 4 each of 18,000 h.p. capacity in the same power house of the Great Western Power Company at Big Bend the same variable hydraulic counter-balance is employed, except that the dimensions of the parts are somewhat different to compensate for different weights and there is a slightly different arrangement of wearing rings.

In the case of the turbine of the Pacific Gas & Electric Company shown diagrammatically in Fig. 3 the variable pressure chamber may contribute an available automatic counter-balancing effort of from 0 to over 200,000 lb.

There is in this turbine, also, provided as supplementary to the above and to relieve the runner hub as far as possible of the water velocity pressure, after the water has left the buckets, are annular stationary shield on which the water is received and from which it discharges into the draft tube, relieving the runner hub of about 20,000 lb. and to this extent relieving the automatic counter-balance or variable pressure chamber of this additional load.

It will be noted that there is but a small quantity of water used in maintaining the variable pressure chamber fully effective, in that the condition therein is not one of "flow" but rather almost a static condition; it only being necessary that the leakage through the joint **C** shall be great or small compared with the leakage by **A** to give the benefit of the full range of variation within **B**. It is of course necessary to provide the usual bearings and is customary also to provide a thrust bearing to take up any slight variations during starting and stopping the units; and in both of those herein described Kingsbury bearings with with oil pressure are also used, but the thrust of the moving water column is automatically counterbalanced by the variable pressure chamber or chambers between the turbine runner and the casing.

In high pressure Francis turbines this factor of the variable water pressure is of the greatest importance and especially so with the single discharge type, as every movement of the turbine gates causes a variation in the water thrust which is simultaneously compensated for by the action within the variable pressure chamber due to the variation in the opening **C**, the variable pressure chamber establishing and automat-

ically maintaining equilibrium under all normal operating conditions.

Where the runner shape will permit it is customary to arrange a variable pressure chamber on each side, as running joints must in any case be provided between the runner periphery and the casing and between the runner and draft casing.

It will be seen from further inspection of Fig. 2 that the action of this second variable pressure chamber may contribute also to the counter-balance—the joint or algebraic sum of the two being secured—for

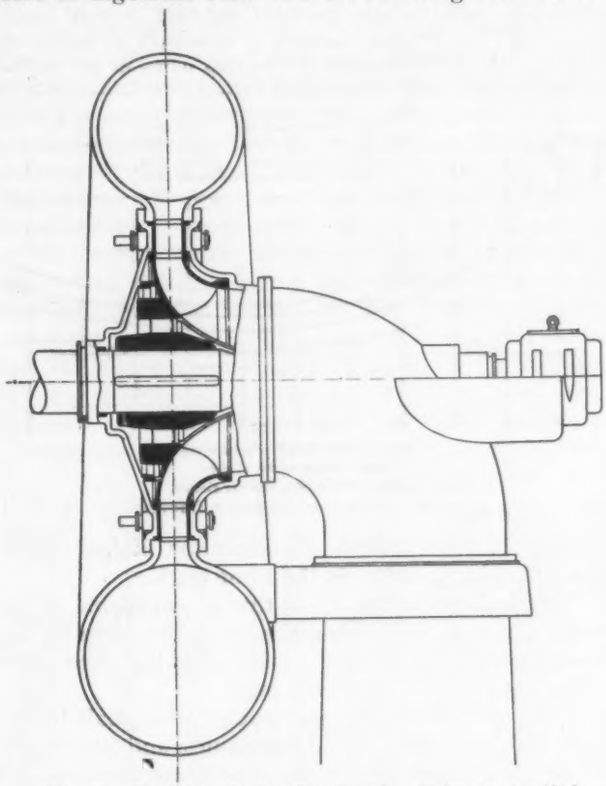


Fig. 3. Variable Hydraulic Counter Balance Applied to Runners in Pelton Francis Units.

if the runner move in an upward direction due to any lack of hydraulic balance the joint **C** closes, increasing the pressure in **B** and at the same time the joint **C'** opens, reducing the pressure in **B'**, so that one chamber may be used to add pressure in one direction and the other to add pressure in the other direction, where such is required.

In the design of the variable pressure chamber it is of course to be preferably of such size that when the impeller or runner is running, a counter-balance will at all times be effected by some pressure within the variable pressure chamber between its minimum and maximum.

In the vertical type the runner will rise as rotation starts until the opening **C** is closed sufficiently to cause the requisite balancing pressure to be established within **B** when it will continue to rotate free from any rubbing or friction contact in perfect equilibrium.

These two designs have been taken to show the characteristic method now generally employed in high head Francis turbines to effect an automatic counter-balance of the hydraulic thrust throughout its variations as met with during the governor control of such a unit and its importance cannot be over estimated.

Although velocity variations are usually caused by the governor action on the turbine gates they are not by any means confined to this as a cause, as fluctuations of tail water or head water surfaces will also occur and as the automatic action of the variable pressure chamber is brought about by any pressure variation, from whatever cause, and instantly corrects therefore, it serves as a perfect solution for an otherwise impossible problem in Francis turbine runners.

Although the simplest way of relieving the discharge from the running joint **C** is through the holes **D** opening into the runner where a pressure exists lower than at **A**, it will be obvious that this discharge from **C** may be vented by a separate channel into any part of the runner or draft, the important point being, that there shall be a material flow by the joint **C** whenever the runner moves to open said joint and that there shall be some restraint to the flow into the chamber **B** from **A** so that upon the plug or piston on flange **C** opening there will be a reduction in pressure within the variable pressure chamber **B**.

The telephone system of New Zealand is being rapidly developed by the national government with up-to-date material and appliances and much of it is now coming from the United States. According to the Government Public Works Statement for 1914, 12 new exchanges were opened and the number of exchange connections increased by 4846. A length of 390 miles of pole line and 2136 miles of wire were added to the telegraph and interurban telephone system, and 515 miles of pole line and 34,325 miles of wire to the telephone exchange local system while 1637 miles of telegraph and interurban telephone lines were overhauled and reconstructed. The service is good and covers the Dominion. The public telephone is exceptionally good, and the charge within the city is only 2 cents for three minutes. The yearly rate for a business phone is $34.06 within half a mile of the exchange, and for a residence phone $24.60, within 1 mile of the exchange, and $2.43 for each additional mile in each case.

The Los Angeles electric distribution question has been passed up to the courts by the California Railroad Commission. The city of Los Angeles had instituted condemnation proceedings as regards the distribution system of the Southern California Edison Company. After an exhaustive investigation and valuation had been made by the commission, the Edison company's attorneys, when the case was opened, declared that the city should condemn all the company's lines in the city and pay damages for the transmission lines that the city does not take on. The commission decided that it is not their function to determine whether the city can by condemnation take a part of a franchise held or exercised by the company, and leave the remainder of the franchise in effect. The commission when called upon must fix the just compensation to be paid for a part of a franchise and if there be controversy as to the legal right of the city to take only such part, this controversy must be settled by the courts. It is possible that the city will proceed with the construction of a competing muncipal distributing system, using aqueduct power.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

(Continued.)

Fuel Oil.

Although almost all forms of carbonaceous and hydro-carbon fuels, from powdered coal to gas, have been tried experimentally in Diesel engines, commercially successful operation has been confined to liquid fuels—more particularly to mineral oils and coal tar. In the United States the relative value of tar is so high, on account of the marketable products obtainable from it and its use for roofing and similar purposes, that there has been no inducement to use it for Diesel engine fuel in preference to the cheap petroleum fuels. It was for this reason alone, that one large gas company, after successfully using the tar from its own works as fuel in its Diesel engines for some years, changed to oil, finding it possible to sell the tar for more than the cost of the oil.

There does not appear to be any limitation to the possibility of using mineral oils in Diesel engines, from the heaviest crudes to refined kerosene, but commercial and practical considerations tend to give preference to fuel oils ranging between 24 degrees and 36 degrees Beaume. The available supply of these fuels is large in proportion to the demand for them, so that they may generally be purchased at prices as low as, or lower, than those of crudes, from which the valuable lighter and heavier constituents have not been abstracted.

Fuel oils, for use in Diesel engines, should contain the lowest proportions of the following impurities, compatible with the prices demanded:

Water—because it is charged for at the fuel oil price; it reduces the efficiency of the engine; it increases the maintenance costs; and it has a detrimental effect upon the regulation. More than one-third of one per cent of water should be considered excessive; and, if fuel containing more than this has been accepted, the water should be settled out, by heating the oil by means of a steam coil.

Sulphur—if in excess of 1½ per cent, the combination of the sulphurous fumes with the vapors of the water combustion, will corrode and pit the exhaust valves and seats, and rapidly eat out the exhaust piping.

Ash—a comparatively minute percentage of entirely non-combustible matter in the fuel causes an accumulation on the oily cylinder walls, between these and the piston, which will result in excessive wear.

Asphaltum—this much abused term is susceptible to so many and various interpretations, that it has no definite significance. Nor has the method for its determination been standardized. The various chemical and mechanical (penetration) determinations have little or no bearing upon the real issue under consideration here; viz., the complete combustibility in a Diesel cylinder under the conditions existing in it and within the available time. A comparison of results obtained in actual use for the above purpose, with oils containing a substance, other than ash, which will not volatilize under certain definite conditions, appears to be the best guide as to the proportion of this substance which will render necessary an excessively frequent cleaning of the cylinder and its adjuncts. Several years of careful observation and records have induced the oldest Diesel engine builders in this country to adopt, for such comparisons, the percentage of residue remaining after the sample of oil has been gradually brought to a temperature of 570 deg. F. and then subjected to this temperature for 120 hours, in a closed furnace, in which combustion does not take place. Under this treatment the sample is reduced to practically constant weight. It has been determined that, so long as this residue is less than 10 per cent of the original weight of the sample, unreasonably frequent cleaning is not necessary. This percentage is equivalent to anywhere from 7 to 30 per cent of "asphaltum," according to the various methods of determination in use. If the fuel oil contains more than the above-mentioned 10 per cent of residue, its use must be guided by the relative cost of the oil, and the cost and inconvenience of labor and stoppages required for the more frequent cleaning. The form of the atomizer does not appear to have any bearing upon this question, as the substance does not become objectionable until after the fuel has entered the cylinder and its most volatile constituents have become gasified; although it may render the fuel so "heavy" that warming is necessary to enable the oil to flow to and be handled by the fuel pump of the engine.

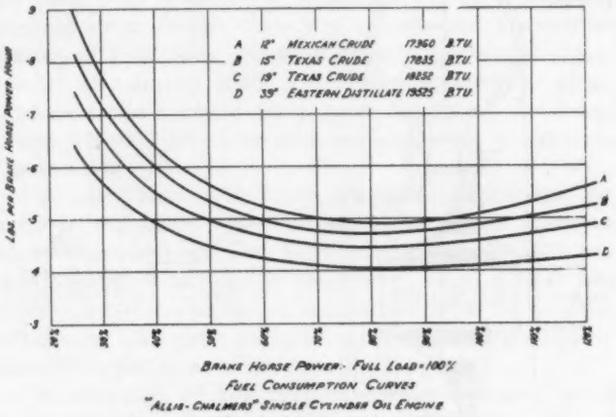

A 12° MEXICAN CRUDE 17350 B.T.U.
B 15° TEXAS CRUDE 17835 B.T.U.
C 19° TEXAS CRUDE 18132 B.T.U.
D 39° EASTERN DISTILLATE 19525 B.T.U.
LBS. PER BRAKE HORSE POWER HOUR
BRAKE HORSE POWER - FULL LOAD = 100%
FUEL CONSUMPTION CURVES
"ALLIS-CHALMERS" SINGLE CYLINDER OIL ENGINE

Fig. 10. Fuel Consumption Curves.

Fig. 10 illustrates the consumption of fuel oils of widely varying gravity, in the same engine.

The fuel oils of the West that are available on the Pacific Coast all fall within the limits set forth by the Diesel manufacturers and a table showing their composition appears on the next page.

This table shows the percentage of asphalt by the Holde test, as usual with oil companies, and also by the test as mentioned above for the determination of asphaltum or residue. Nos. 1, 2 and 3 are products of the refinery, having the gasoline removed. The oils sell for approximately the price noted and the California oil least fitted for use in the engine, No. 2 of the table is the most economical if the selling price is from 1-8 to 1-10 of a cent less per gallon than such oil

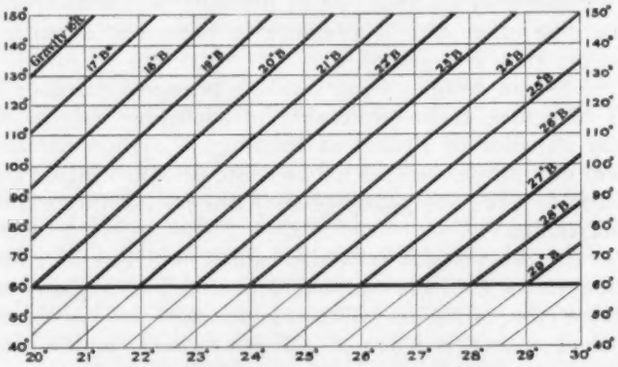


Fig. 11. Gravity Correction Curve for Temperature.

as Calol fuel oil No. 1 or Diesel fuel oil No. 3, considered to be the most adaptable, commercially, of the California oils. It would appear more economical to use No. 2, not taking into consideration the cost of heating this low gravity oil to make it flow readily to the fuel oil pump. The Mexican oils are expensive at any price, due to the high sulphur content. It may

Composition of Fuel Oils.

Producer:	No. 1 Standard Oil Co.	2 Union Oil. Co.	3 Union Oil Co.	4 King Oil Co.	5 Coalinga				
Trade Name:	"Calol"	Regular	"Diesel"	rude Oil.	Crude.	———	Mexican	Crude.	———
Heat Value.	Fuel Oil.	Fuel Oil.	Oil.	C19,229	18,642	18,127	18,097	18,776	18,499
B.t.u. per lb.....	19,250	19.136	18,862	29.2	19.4	17.46	19.5	17.6	18.5
Gravity °B. at 60° F....	27.2°	15.7	24.2	130	149	186	182	268	97
Flash Point °F	212	146	126	145	201	213	212	237	138
Burning Point °F.....	234	304	153	1.18%	.66%	2.12%	2.0%	2.44%	3.92%
Sulphur	.74%	.89%	.81%	.08%	.68%				
Water	.08%	.08%	.08%	.2%	9.8%	39.3	43.7	53.0	54.9
Residue	3%	15.1%	3.9%						
Asphalt Holde Test.....	25%	50%	20%						
Price f.o.b. ..... Refinery per bbl.	80c	70c	80c	65c f.o.b. Field.	60c f.o.b. Field.				

be roughly stated that any oil that will flow through a 1 in. pipe from a gravity tank and available for purchase on the Pacific Coast can be used in the Diesel engine. If the oil is at such a gravity that it will not flow at room temperature it must be heated. This can be easily accomplished by making use of the water for cooling the engine which usually flows out at 110 degrees to 130 degrees. Fig. 11 shows the effect of temperature upon gravity. A 20 degree Beaume oil at 60 degrees Fahr. heated to 100 degrees Fahr. is equivalent to a 22.5 degree Beaume oil and its viscosity will be increased and the oil will flow more readily. Although oil is generally spoken of in degrees Beaume the real comparison should be based on specific gravity, the relative weight per unit of volume compared to water at a given temperature. The table showing this comparison follows:

Data for Fuel Oil.

Specific Gravity.	B.°	Wgt. Gal.	Wgt. Bbl.	Wgt. Cu. Ft.	Cu. Ft. Ton.	Gal. Ton.	Bbl. Ton.
1.0000	10	8.33	349.86	62.355	35.9	268.9	6.43
.9929	11	8.27	347.34	61.912	36.1	270.8	6.46
.9859	12	8.21	344.82	61.475	36.5	272.8	6.50
.9790	13	8.16	342.72	61.045	36.7	274.6	6.54
.9722	14	8.10	340.20	60.621	36.9	276.6	6.59
.9655	15	8.04	337.68	60.202	37.2	278.6	6.65
.9589	16	7.99	335.58	59.792	37.5	280.3	6.69
.9523	17	7.93	333.06	59.380	37.7	282.4	6.73
.9459	18	7.88	330.96	58,981	38.1	284.2	6.77
.9395	19	7.83	328.86	58.582	38.3	286.	6.82
.9333	20	7.78	326.76	58,195	38.5	287.9	6.86
.9271	21	7.72	324.24	57.809	38.8	290.	6.91
.9210	22	7.67	322.14	57,428	39.	292.	6.96
.9150	23	7.62	320.04	57.053	39.2	293.9	7.01
.9090	24	7.57	317.94	56.680	39.5	295.7	7.06
.9032	25	7.53	316.26	56.319	39.8	297.4	7.09
.8974	26	7.48	314.16	55.957	40.1	299.4	7.14
.8917	27	7.43	312.06	55.601	40.3	301.4	7.18
.8860	28	7.38	309.96	55.149	40.6	303.5	7.24
.8805	29	7.34	308.28	54.903	40.8	305.2	7.28
.8750	30	7.29	306.18	54.560	41.1	307.2	7.32
.8484	35	7.07	296.94	52.991	42.4	316.8	7.55
.8235	40	6.86	288.12	51,349	43.7	326.3	7.78

The above table is based on the formula $\frac{140}{130 + ° \text{Be.}} = \text{Sp. Gr.}$

For each 10° F. above 60° F. add 0.7° Be.
For each 10° F. below 60° F. subtract 0.7° Be.
42 gal. = 1 bbl. 1 ton = 2,240 lb.

The matter of using the lower gravity and lower priced oil is a matter that must be determined in each separate installation, based on the character of the service the engine has to perform. Uniformity of the oil that has passed through the refinery is of extreme value, its composition between limits being guaranteed by the seller while the composition of native crude oil is exceedingly uncertain. It is easy to understand that the cheapest oil is not always the most economical, for the cost of repairs and attention will necessarily increase as the quality of the oil decreases. It has been the experience of a large majority of Diesel users that the slight increase in the cost of the better oil is economical and advisable in the long run, just as the use of fuel under boilers, particularly of coal, the cheapest coal is not necessarily the most economic fuel.

Guarantees for fuel consumption will be maintained with oil falling within the following limits:

Gravity at 60 degrees F. not heavier than 20 degrees nor lighter than 40 degrees Beaume.

Flash point between 125 and 250 degrees F. burning point between 160 and 300 degrees F.

Sulphur between .5 per cent to 1½ per cent.

Water not over .3 per cent.

Ash not over .01 per cent.

Residue not over 10 or 15 per cent.

Heat Value: The heat value usually ranges between 18,000 British thermal units (B.t.u.) per pound and 19,000 B.t.u. per pound.

Flash and burning points are specified on account of the hazard of storage. If the oil is stored underground a flashpoint as low as 95 degrees F. and 125 degrees F. may be used. On the newer type engines sulphur as high as 2½ per cent is not objectionable.

A residue of 10 per cent is conservative. Many plants are in operation successfully with fuel as high as 15 per cent based on the test for 120 hours. This is equivalent to approximately 30 per cent asphaltum by the Holde test. It may be stated, however, that usually manufacturers are very conservative as to the quality of oil recommended for use in the engine, while some others are prone to make extravagant statements that cannot be lived up to in practice with good service.

The production of fuel oil and its future is a question that presents itself to every prospective Diesel engine purchaser. The table shown herewith gives the production of oil as compiled by the United States Geological Survey. As the oil generally used in a Diesel engine throughout the United States is practically a by-product of gasoline, there is little likelihood of it ever increasing in price beyond a reasonable limit. The fact that all of the principal oil producing companies in the United States have oil to offer that is acceptable to the Diesel engine users and competition may at all times be expected is another point to be taken into consideration in regard to an advance in price. The oil for Diesel engines is not available in drums or barrels being shipped in tank cars of from 6000 gallons to 12,000 gallons capacity. The plant usually has a tank of sufficient capacity to take a carload with a slight overlap, a 12,000 gallon tank being sufficient with the size tank car now in use.

Oil Production in Barrels.

State.	1914.	1913
California	103,000,000	97,788,525
Oklahoma	98,000,000	63,579,384
Illinois	21,000,000	23,893,899
Texas	20,000,000	15,009,478
Louisiana	15,000,000	12,498,828
West Virginia	11,000,000	11,567,299
Ohio	7,500,000	8,781,468
Pennsylvania	7,000,000	7,963,282
Wyoming	4,600,000	2,406,522
Kansas	2,700,000	2,375,029
Indiana	700,000	956,095
New York	800,000	902,211
Kentucky	500,000	524,568
Colorado	150,000	188,790
Other States	50,000	10,843
	292,000,000	248,446,230

(To be continued.)

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
A. M. HUNT, Treasurer and Special Contributor
C. L. CORY, Secretary and Special Contributor
ROBT. SIBLEY, Director and Special Contributor

CHICAGO OFFICE: 537 SOUTH DEARBORN ST.
JOSEPH H. EVERSTON, Advertising Representative

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each,	.25

NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

CONTENTS

Calgary's Electric Supply System 457

The St. Paul Electrification 460

Discharge of the Columbia River at The Dalles 461
By Fred F. Henshaw.

Electric Cable Between Denmark and Sweden 464

Controlling the Water Column in Hydroelectric Plants 465
By Geo. J. Henry.

The Telephone System of New Zealand 467

The Los Angeles Electric Distribution Question 467

Diesel Engine Practice 468
By J. E. Megson and H. S. Jones.

Editorial 470
Diplomacy in Collecting Bills.
The Curve of Learning.
Public Utility Districts.

Personals 472

Obituary 472

Meeting Notices 472

Jobbers at Del Monte 473

Industrial 474

News Notes 475

Diplomacy in Collecting Bills

A first-class preparation for any central station employe who comes in contact with the public would be a year's service in the U. S. diplomatic corps. This does not imply that William Jennings Bryan, former Secretary of State, would necessarily qualify, though a bill collector must preeminently be a man of peace. Tact is necessary in adjusting individual complaints, and diplomacy is essential in collecting bills from the public collectively.

One of the best incentives to prompt payment of bills is a liberal discount. But in these days of regulation the rates fixed are seldom sufficient to allow such discounts and other methods must be adopted. The problem, primarily, is one of education. When the public understands that a public service company is no different from any business concern as regards the necessity for meeting its obligations, when the people realize the restrictions prescribed by public service commissions, and when they appreciate the cumulative embarrassment caused by delay in paying for service, the spirit of fair play will prompt them to pay promptly.

The worst form of discrimination in all lines of business is the dead-beat. He is a parasite on society and the cost of serving him has to be borne by the honest and self-respecting element. Formerly public service corporations had recourse to the shut-off man, but now even this form of alleviation is denied in some states and reliance must be placed upon diplomacy.

This might well constitute an important part of the advertising plans of a public service corporation. Corporation publicity affords a good chance for educative work. The necessity for prompt payment of bills can be easily inculcated in advertising matter and the public thus brought to a sympathetic understanding of the situation.

The Curve of Learning

The fundamental mistake in many an organization is the lack of praise for work well done. Fault finding takes precedence over commendation. Contray to common opinion, slave-driving does not make for efficiency. This common-sense view, rightly enough, is corroborated by recent psychological experiments as to the best methods of teaching. As every business manager should be a teacher it is possible to extract from these theoretical investigations a few practical principles which can be applied in any organization.

To begin with, it has been found that the rate of improvement in learning is governed by a "curve of learning." In general, there is a rapid rise at the beginning of learning, then a "plateau" period of less rapid improvement, and finally a gradual rise. The "plateau of learning" represents the period of no apparent progress. It coincides with the experience of everybody in learning anything. It is the time when interest is lost and discouragement starts.

The psychologist finds that this is the invariable accompaniment of learning. It may perhaps be best illustrated by the experience in learning telegraphy. During the time that the beginner is learning letters and words progress is rapid. Later, while these processes of mechanization are being grasped by the mind which is also trying to learn how to receive connected discourse, progress is slow, the length of the plateau being but a measure of the degree of difficulty in the process of mechanization. When this has been mastered, advancement is then rapid. During the plateau period it is difficult for the beginner to quickly remember any one of a large number of elementary facts which he has learned but does not yet know how to apply.

Successful men are undoubtedly those who have the persistence or necessity to stay with discouraging work during the plateau period. Unsuccessful men are those who give up when they see no evidence of progress. Consequently if this scientific truth were more fully realized, if men understood the reason for the inevitable period of apparently marking time, many a discouraging task would be carried to a successful conclusion.

Here, then, is the opportunity for the manager teaching his assistants. They do not know whether they are improving and when they are not without some expression of approval or disapproval from their superior they become disheartened. Until they are able to distinguish their mediocre from their good work, they are unable to cultivate the attitude of satisfaction with improvement, which, by the way, is the most powerful agent for efficient work. Efficiency varies with the satisfaction afforded by work done.

So the manager should tell his assistants that this plateau region is an invariable preliminary to attaining great success. It is the period of preparation. Once this stage is passed, ultimate success is in sight. This means, of course, that praise must always be tempered with blame, when blame is due. Furthermore, in the words of Francis Bacon, while "praise is one of the things which almost everybody must wish for, and be glad of, yet which it is not allowable to seek for as an end."

Public Utility Districts

Considerable interest and speculation has arisen, like murky mists in the tossing sea of public opinion, regarding the purpose and effect of the public utility district act in California. This act was passed by the legislature and was approved by Governor Johnson on May 27, 1915. Such districts are now being formed for various purposes in different localities and the provisions of the bill are worthy of study.

The act specifies the organization and powers of bodies which may be formed by the union of two or more municipalities, or by the union of incorporated and un-incorporated territory, for the acquirement, construction and operation of works for the supply of water, light, power, heat, transportation, telephone service or other methods of communication. Certain individuals, for example, are now agitating the formation of a district among the cities of Oakland, Berkeley and Alameda in order that an adequate water supply may be secured. Similarly a district was recently formed in Marin county to acquire the properties of the existing water company.

Their first procedure is to get at least fifteen per cent of the electors in each municipality to sign a petition calling an election to ballot on the formation of a public utility district within specified boundaries. If passed by a majority vote the legislative body shall declare the district formed.

A board of directors consisting of as many members as there are individual units, together with three or four additional members so as to make an odd number on the board, shall be elected within three months, each director holding office for four years and receiving a compensation not to exceed three thousand six hundred dollars. The board has power to appoint a clerk, accountant, treasurer and general manager, all other employes being selected by civil service.

This board has much the same powers as any private corporation and also can exercise the right of eminent domain. It can take the initiative in the acquisition or construction of a public utility or this may be done by the electors through a petition signed by fifteen per cent of all voters.

The cost of the utility may be paid either out of the revenues of the district or by incurring a bonded indebtedness. The act provides that only revenue-producing utilities shall be acquired, owned or operated by the district, it being the intention that all charges and expenditures and the interest and principal on the bonded debt be paid from revenue derived from the operation of the district's utilities.

The plan is thus seen to be merely an enlargement of schemes for municipal ownership and operation of public utilities. The entire organization is political in character and to that extent is undesirable. As has frequently been re-iterated in these columns it will be necessary to divorce political operation from government ownership of public utilities if any premanent success is to be attained in this idealistic method of serving the public.

In a number of instances where it has been proposed to form public utility districts many of the active proponents have had axes to grind, nor were these axes intended to cut out the Ethiopean in a woodpile. There is little likelihood that the public will not be informed of the motives of men whose skirts are not clean when seeking public approval of these utility districts. And to that extent, at least, protection can be secured against this insidious form of political operation.

PERSONALS

W. S. Berry, sales manager for the Western Electric Company at San Francisco, is visiting Seattle.

R. L. Webb of the power department of the Efficiency Engineering Company of Portland, Ore., is at San Francisco.

R. St. John of the General Electric Company, Los Angeles, Cal., has returned south after a brief visit to San Francisco.

Paul M. Downing, chief hydroelectric engineer of the Pacific Gas & Electric Corporation, has returned from Washington, D. C.

H. A. Lardner, manager J. G. White Engineering Corporation, will return about the first of the year after an extended trip in the East.

E. D. Farrow, general agent of the San Joaquin Light & Power Company, Fresno, was a visitor at San Francisco during the last of the week.

F. Van Vleck, manager of the Bristol Company's booth at the P. P. I. E., is leaving for Washington, D. C., to take charge of their office there.

E. A. Robison has been appointed city electrician at Redding, California, his first duty being the construction of a municipal lighting system.

Chas. Wirt, president of the Wirt Company, makers of Electric Lighting Appliances, Germantown, Pa., has returned East after spending a few weeks on the Coast.

D. W. Hershey of the Heavy Traction Division of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., was a recent visitor at San Francisco.

T. W. Simpson, manager Federal Sign System (Electric) recently returned to San Francisco from a business trip throughout the Sacramento and San Joaquin Valleys.

W. H. Gribble, formerly with the Kimball Electric Company of Oakland, Cal., has recently opened a new supply house at Chico, known as the Western Gas & Electric Appliance Company.

F. P. Bailey of Modesto, Cal., was in San Francisco this week buying electrical supplies for the new store he is going to open up in Modesto, to be known as the F. P. Bailey Electric Company.

L. F. Parker, engineer in charge of the manufacture of heating devices of the General Electric Company at Pittsfield, Mass., will leave for the East about the middle of next week, after a brief business trip on the coast.

F. C. Gibson of Portland, Ore.; **H. Z. Mitchell** of Seattle and **J. F. Rogan** of Los Angeles, representatives of the Edison Storage Battery Supply Company, were recent visitors at San Francisco, where they attended the sales conference of their company.

Frederick P. Stearns, Boston; **William Mulholland,** Los Angeles, and **R. H. Thompson,** Seattle, have been selected by City Engineer Dimock to investigate and report on plan for sealing the Cedar River impounding basin of the Seattle municipal plant.

R. L. Eltringham, electrical engineer of the Industrial Accident Commission, has returned from Washington where he attended the recent conference between the Bureau of Standards and the representatives of the power industries of the United States.

H. N. Keifer, sales manager with the Northern Electric Company of Vancouver, B. C., was elected secretary of the Vancouver branch of the American Institute of Electrical Engineers at their last meeting. Mr. Keifer succeeded **K. A. Auty,** formerly with the B. C. Electric Railway, who has left for New York City.

OBITUARY.

William Andrew Conner, of Plainfield, N. J., died suddenly Monday at his office in Perth Amboy, N. J. He was born in Baltimore, September 12, 1859. He began his business career in 1876, in Pittsburgh, in the oil refining business, in which he reached the position of assistant manager for the Standard Oil Company. In 1885 he took charge of the first plant built by the Standard Underground Cable Company in Pittsburgh, and from then to the time of his death he was the head of the manufacturing business of that company, including large plants planned and built by him in Pittsburgh, Pa.; Perth Amboy, N. J.; Oakland, Cal., and Hamilton, Canada. He was a director for ten years and first vice-president since 1909. He was vice-president of the Perth Amboy Trust Company, in whose inception he had an active part. He was a cousin of E. J. Waring of the Standard Underground Cable Company and of the late Richard S. Waring, the founder of the company and the inventor of "Waring" cables.

Eben Freme Wells, director and treasurer of the Home Telephone Company of Portland, died December 8th at Portland, from a stroke of apoplexy. He was 64 years of age and a native of Brattleboro, Vermont. After graduating from Cornell university he took up railroad work, entering the auditing department. During the construction of the Northern Pacific he was station agent for a number of years at Glendive, Mont. From there he went to St. Paul, where he remained for several years. During this period, about 30 years ago, he became acquainted with Samuel Hill, with whom he has been intimately associated since. When Mr. Hill took up the reorganization of the Seattle Gas Company a number of years ago, Mr. Wells came to the Pacific Coast and became general manager of the new organization. He served in this capacity a number of years and then returned to Minneapolis, where he was employed by Stone & Webster. When Mr. Hill began the organization of telephone companies in the northwest Mr. Wells was recalled to aid him and he came to Tacoma in 1909, as director of purchases and treasurer. A few months later he took up his residence in Portland as treasurer and purchasing agent of the Home Telephone Company.

MEETING NOTICES.

Vancouver A. I. E. E. Section.

The Vancouver, B. C., section of the American Institute of Electrical Engineers has arranged a comprehensive schedule of monthly meetings for the 1915-1916 term. On November 25th W. R. Fraser read the N. E. L. A. paper on "The Electric Vehicle and the Central Station," and on December 16th C. D. Howe presented a paper on the "Vancouver Grain Elevator." The following schedule has been arranged for the balance of the term: January 14, 1916, "Industrial Power Applications" (Industrial Power Committee Lecture) A. I. E. E.; February 17, 1916, "The City of Kamloops Power Plant and Pumping System," H. K. Dutcher; March 16, 1916, "Electric Dredging and Hydraulic Sluicing," F. D. Nims; April 13, 1916, "Water Powers of British Columbia," G. C. G. Conway.

The Jovian Electric League of Southern California.

The luncheon of the League, held at Christopher's Los Angeles, on December 8th, was attended by about 100 Jovians and a number of out-of-town guests. Tribune Holland announced that a home had been secured for the Jovian girl and the bond for the boy had been entirely paid for. Chairman Graham of the Rogan Cup Committee reported that it was decided to have Mr. Starr's name engraved on the cup in view of the highly successful Edison day meeting, over which he presided. A splendid musical program was rendered by Messrs. Brown and Blyler, of McKee's and chairman of the day Z. Howard Sherart, then introduced guest Ingold, an authority on advertising, who had chosen "After Effects" as his topic. He sketched the marvelous industrial

developments during the past twenty-five years due to the inventive genius of man, gave high praise to the celebration of Electrical Prosperity Week, predicting beneficial after effects and voiced the opinion that electricity, in one form of invention of another, will no doubt have a decided influence on the settlement of the present European conflict.

Portland N. E. L. A. and A. I. E. E. Section.

The fourth bi-monthly luncheon of the Portland sections of the A. I. E. E. and N. E. L. A. was held December 9th in the Commercial Club, Portland, Oregon. Clyde B. Aitchison of the Public Service Commission of Oregon gave an address on "The Need of a Consistent State Policy in Dealing with Public Utilities." Mr. Laing, counsel for the Pacific Power & Light Company, acted as chairman.

The regular monthly meeting of the local sections of the N. E. L. A. and the A. I. E. E. was held Tuesday evening in the Electric building, Portland, December 7th. J. C. Martin, electrical engineer of the Pacific Power & Light Company, was to have given a report on the conference before the Bureau of Standard, Washington, D. C., but due to sickness he was unable to present same. Mr. Martin was a delegate to this conference. It was also announced that Mr. Ryan would not be able to give the talk which had been scheduled for the coming week, as he had been called East. The talk was to be given on the subject of the Electrical Illumination of the Panama-Pacific Exposition. Mr. Hall, local manager of the Pacific Power & Light Company at Hood River, Oregon, presented the meeting with two fine boxes of apples. A unanimous vote of thanks was sent him. J. E. Davidson presided as chairman. The paper of the evening was read by A. C. Brill, district eugineer of the Pacific Telephone & Telegraph Company. His subject was "The Building of the Transcontinental Telephone Line."

LEIVER KYNG WASS-HAEL.

The following notice has been sent out to electrical men of San Francisco:

Yr Gude Selfe is agayn bidden to ye Fifth Annual Feftival of Wass-hael to be held thif year on Saturdaie afternoon next before Chriftmaffe on ye eighteenth of December, 1915, Anno Domini, about ye hour of one of ye clock, in ye publick houfe of Ye Castilians on Sutter Strete, nombered 344, where our hoft will generoufly ferve young turkeys well roaited & spiced, new victuals of rare and pleafing poignancy, plum puddings, and choice wynes, till ye eyes of our rubicund potentates do wander in ye haze of an Indian Summer.

Since our chairs be limited to One Hundred, thofe firft refponding with their cheques for two dollars will be provided for without favour until all tickets be sold, & thereafter none can be accepted. Tickets may be secured from yr obedient servants:

Thomas E. Collins
Nicholas K. Cooper
Joseph S. Thompson
Harry H. Daley
Sandy Sanderson
Walter L. McKinley
Robt. L. Eltringham
A. Emory Wishon
Wm. S. Hanbridge
Arthur H. Halloran
Kendall L. Dazey
Eugene Zimmerman
Richard F. Behan
Fred. A. Poss
Joseph A. Herr
Albert E. Drendell
Edgar A. Wilcox
Miles Steele
Harry H. Hoxie
Murray Orrick

ELECTRICAL JOBBERS AT DEL MONTE.

The quarterly meeting of the Pacific Coast Electrical Supply Jobbers' Association was held at Del Monte, December 6, 7 and 8, with an attendance of 34. Golf, as usual, was the all-absorbing pursuit, with the team play for the new trophy presented by the Pacific Coast representatives of Eastern electrical manufacturers as the center of interest. The manufacturers won this by the overwhelming score of 12 to 1, as shown in the following:

Team Play for Manufacturers' Cup.

Jobbers—		Manufactures—	
Hillis	1	Sanderson	
Hall		Dunbar	
Goodwin		Davis	
Berry		Oakes	3
Leggett		Young	
Averill		Murray	3
Carter		Hall	
Fobes		Van Kuran	3
Elliott		Bibbins	
Burger		Gregory	3
	1		12

W. L. Goodwin won the Pass & Seymour cup and H. V. Carter the jobbers' copper cup and the Del Monte trophy, the scores following:

	Pass & Seymour.			Copper Cup.		
	Gross.	Hdcp.	Net.	Gross.	Hdcp.	Net.
Averill	...	...	...	130	—16	104
Berry	114	—10	104	110	—10	100
Burger	108	0	108	108	0	108
Carter	104	+5	109	93	+5	98
Fobes	...	...	...	138	—30	108
Goodwin	94	+5	99	99	+5	104
Hall	...	...	...	105	—6	99
Hillis	93	+12	105	88	+12	100
Leggett	111	—6	105	99	+5	104

The manufacturers' cup and the Del Monte trophy was won by W. Brewster Hall, the scores following:

	Gross.	Hdcp.	Net.
Bibbins	105	—2	103
Davis	90	+4	94
Deming	108	0	108
Gregory	101	+5	106
Hall	93	—5	88
Newbert	130	—24	106
Sanderson	91	+15	106
Vandegrift	139	+24	115
Van Kuran	112	+5	117
Walton	131	+24	107
Young	99	+5	104

On Wednesday evening Mr. O. D. Young, general counsel for the General Electric Company, gave an inspiring address, emphasizing the value of the human element in organizations.

At the open meeting on Wednesday afternoon S. V. Walton and Lee H. Newbert told of the socket appliance campaign being carried on by the several jobbers in the territory of the Pacific Gas & Electric Company. This territory has been divided into seven districts and each jobber will work each district in rotation for two months each, taking fourteen months for each jobber to work in each territory. For the two months' period commencing November 29 the Oakland district has been assigned to the Western Electric Company; Berkeley to Dunham, Carrigan & Hayden; San Jose to the Electric Appliance Company; Marin county to the Electric Railway & Manufacturers' Supply Company; Solano county to the Simplex Electric Company; Butte county to the Pacific States Electric Company, and Sacramento to Holabird, Reynolds Company. It is, as yet, too soon to state detailed results. The campaign, however, is progressing satisfactorily to the Pacific Gas & Electric Company.

The following were in attendance:

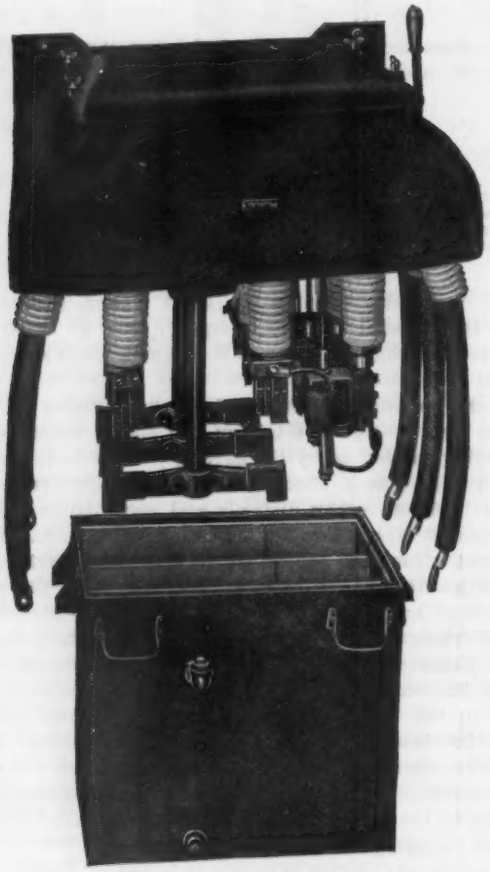
Mr. and Mrs. Geo. C. Holberton, Pacific Gas & Electric Co.
Mr. and Mrs. T. W. Simpson, Federal Sign System (Electric).
Mr. and Mrs. K. E. Van Kuran, Westinghouse Elec. & Mfg. Co.
Mr. and Mrs. O. D. Young, General Electric Co.
F N. Averill, Fobes Supply Co., Portland.
W. S. Berry, Western Electric Co., San Francisco.
T. E. Bibbins, General Electric Co., San Francisco.
Theo. E. Burger, Western Electric Co., Los Angeles.
H. V. Carter, Pacific States Electric Co., San Francisco.
W. M. Deming, General Electric Co., Schenectady.
W. A. Dunbar, Westinghouse Elec. & Mfg. Co., San Francisco.
R. J. Davis, Century Electric Co., San Francisco.
A. H. Elliott, Secretary of Association, San Francisco.
E. N. Fobes, Fobes Supply Co., Seattle.
C. L. Gilson, Gilson Electrical Supply Co., Oakland.
W. L. Goodwin, Pacific States Electric Co., San Francisco.
S. B. Gregory, Arrow Electric Co., San Francisco.
Brewster Hall, Pass & Seymour, San Francisco.
C. B. Hall, Illinois Electric Co., Los Angeles.
A. H. Halloran, Journal of Electricity, Power and Gas.
C. C. Hillis, Electric Appliance Co., San Francisco.
H. H. Hoxie, Electric Railway & Mfrs. Sup. Co., San Francisco.
F. H. Leggett, Western Electric Co., San Francisco.
F. H. Murray, National Carbon Co., Los Angeles.
Leo H. Newbert, Pacific Gas & Electric Co., San Francisco.
R. F. Oakes, American Ever Ready Co., San Francisco.
H. E. Sanderson, Bryant Electric Co., San Francisco.
H. B. Squires, H. B. Squires Co., San Francisco.
J. N. Vandegrift, Oakland Lamp Works, Oakland.
Garnett Young, Telephone & Electric Equip Co., San Francisco.

INDUSTRIAL

AUTOMATIC POLE LINE OIL SWITCH.

A new pole line oil switch has been developed which automatically opens the circuit in which the switch is connected if the current in that circuit exceeds a certain definite amount for which the tripping mechanism is set. In many cases the use of this switch in connection with pole type transformers obviates the necessity of bringing high tension lines into a building.

The switch is closed by a handle affixed to the frame. The automatic operation on overload is effected by tripping coils in series with the line. These coils are located in the oil vessel under oil and are connected to a common tripping



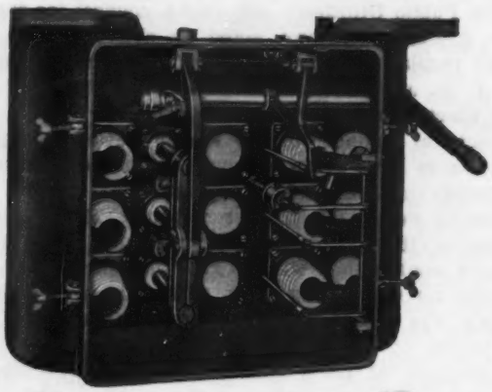
Type F, Form P7 Automatic Oil Switch with Three-Coil Series Time Limit Trip.

lever by separate wooden rods. The tripping device may be actuated by any one of the overload trip coils, or by a hand operated trip rod—not visible, but outside the switch frame. The switch can not be opened by the closing handle. An inverse time oil dashpot connected to the tripping device affords a time delay in automatic tripping.

Insulated cables enter the switch from below through porcelain bushings in an overhang on the switch frame. The space between cables and these bushings as well as other bushings through which the cables partly run, is filled with insulating compound. There are no uninsulated parts within the switch frame.

The oil vessel has an insulating lining, wooden barriers between poles and between trip coils, drain cock and filling tap so that the oil may be changed without lowering the vessel, and handles to assist in handling the switch or in removing the vessel for inspection of the contacts, which are of the sliding wedge type of construction. This switch is thoroughly weather-proof.

With the exception of the operating lever and hand tripping rod, all parts are enclosed and protected from the weather. The cover is grooved on the under side to fit close-



Type F, Form P7 Automatic Oil Switch. Top View, Cover Removed, showing Time Limit Dashpot.

ly over the edge of the frame. The oil vessel fits around a flange on the bottom of the frame.

This switch can be obtained single, double, triple or four pole, single throw, for use up to 15,000 volts and 300 amperes. It is built by the General Electric Company, Schenectady, N. Y.

TRADE NOTES.

The Baker-Joslyn Company has established permanent quarters in Los Angeles at 353 E. Second street, where both warehouses and offices will be located in the future. This gives them adequate warehouse space for complete stocks of all their lines, with trackage and easy shipping facilities. Mr. A. E. Ravenscroft, manager of this company for Los Angeles, will be in charge.

The Westinghouse Electric & Manufacturing Company is putting out a new type of motor for sewing machines, direct connected without belt, giving perfect control to the needle from zero up to 1800 stitches per minute. An adjustable stop is provided so that the operator may easily adjust the maximum speed. The acceleration is always smooth, regardless of what speed is desired.

The State School of Mines at Socorro, N. M., has recently put in a well equipped new power plant, consisting of two Semi-Diesel Fairbanks-Morse Type "Y" oil engines. One of these engines is 50 h.p. and is direct connected to a Fairbanks-Morse 37½ k.v.a. generator of 440 volts. This engine has sufficient power to operate all the machinery in the various buildings. The other engine is somewhat smaller and is used for generating direct current for light and laboratory purposes.

NEW CATALOGUES.

"Meters for Automobile Testing" are described and their particular advantages brought out in folder No. 4321 just issued by the Westinghouse Electric & Manufacturing Company. Issue No. 24 of "Small Motors," published by the Small Motor Department of the company, shows a number of illustrations of the fractional horsepower motor and some of its numerous applications.

NEWS NOTES

INCORPORATIONS.

OATMAN, ARIZ.—Application for a charter has been made by J. Huntington Davis of Mazona to incorporate the Mazona Light & Power Company, of which he is president. The company is incorporating for the purpose of distributing electric light and water to residents of Mazona and adjacent townsites. The company will erect a concrete building for office purposes.

POCATELLO, IDAHO.—Articles of incorporation have been filed for the Pocatello Traction & Interurban Company and a project is started that may eventually provide Pocatello with a street railway system. The incorporators are Richard Douglas, John Fraser, N. H. Lathrop, C. E. Lony, Carl Barnard, O. W. Gray, E. S. Anderson and others. Richard Douglas is president, John Fraser, vice-president, and Clark Gibson secretary-treasurer. The company is capitalized at $100,000.

ILLUMINATION.

SCOBEY, MONT.—The Scobey Electric Light Company plans to increase and enlarge its plant at this place.

WENDELL, IDAHO.—The installation of ornamental street lighting system at this place is under consideration.

LAMANDA PARK, CAL.—An election will be held December 22 to vote on the question of forming the "Lamanda Park Lighting District of Los Angeles County."

RENO, NEV.—The city council has plans under consideration for the installation of electroliers in the downtown district, which call for eight lights to the block.

RED BLUFF, CAL.—The city trustees have appointed a committee to meet with a committee of Main street merchants regarding the proposed new lighting system for Main street.

HUNTINGTON BEACH, CAL.—An election will be held on December 28th to vote on the question of issuing bonds in the sum of $20,000 for the construction of a gas distributing system.

NEWPORT, CAL.—An ordinance has ben adopted by the city council ordering an election on December 28th to vote on the question of issuing $30,000 in bonds for the construction of a gas distributing system in this city.

CALEXICO, CAL.—City official have signed a contract with the Holton Power Company for the establishment of a lighting system. There will be six 600-candle lights, fourteen 400 candle and twelve 250 candle power lamps.

RIVERSIDE, CAL.—A contract for an ornamental lighting system, consisting of 444 one-light concrete posts, in a portion of the city known as "east side," has been awarded to the City Electric Company on the bid of $12,915.94.

FILLMORE, CAL.—The committee on additional street lights made its report to the city trustees and if satisfactory arrangements can be made with the power company new lights will be erected at points in the city where needed.

BERKELEY, CAL.—The city council has passed a resolution of intention to establish a lighting district to be known as Lighting District No. 1, and providing for the installation of electroliers, conduits, etc., for the district, which includes Derby street and the east line of College avenue.

ESCONDIDO, CAL.—A. W. Wohlford, banker, states that he and his associates might look into the proposition of supplying Ramona and surrounding sections with electric lights and power. The controlling interest in the Escondido Utilities Company, whose affairs are now in the hands of the Union Trust & Savings Bank of Los Angeles, as trustee, is held by A. W. Wohlford and associates. It is reported that he may be a party to an arrangement to purchase electric current in bulk from the Mutual Water Company delivered to the city limits, in which instance the generating plant of the company would be used for auxiliary purposes in the operation of the electric light and power plant of the Mutual Water Company.

TRANSMISSION.

CHEHALIS, WASH.—The North Coast Power Company is planning the construction of a power line from Woodland to Vancouver to pass through Ridgefield and La Center.

LOS ANGELES, CAL.—Special Counsel Mathews and E. F. Scattergood have been named as a committee to consider the employment of an expert to make a study of the power possibilities of Big Pine and Cottonwood Creeks, and of the Owens River gorge.

SEATTLE, WASH.—It is likely, if plans for the purchase of an additional power plant by the city are agreed upon that a bond issue of $3,000,000 will be submitted to the voters at the general election on March 7th next, according to Superintendent of Lights J. D. Ross.

BILLINGS, MONT.—The Big Horn Irrigation & Power Company plans a large development project to include a 1000-foot dam to be 415 feet high and 400 feet thick at base and 30 feet at top. About 200,000 horsepower will be generated and surveys for a railroad to extend from Custer to the site of the dam are completed, the cost of which will be $800,000. The project is to cost $12,000,000. Work on the irrigation district is to be started soon after the completion of the dam and power plant. J. J. Harris, Hardin, Mont., is interested in the project.

FRESNO, CAL.—The San Joaquin Light & Power Corporation has planned several new extensions of its service, according to A. G. Wishon, general manager. Since September the company has made several large expenditures in the way of service stations and other plant improvements and construction. The books of the company show that up until October 31, a total of $144,072 had been expended for development. In the near future work will be commenced on a steam plant at Santa Maria. This plant will be employed to increase the service strength to the coast towns, as Santa Maria is at the end of a 224-mile line, which connects with the San Joaquin power house. The steam plant will provide extra voltage, proving of especial advantage to San Luis Obispo, Santa Maria, Paso Robles and other towns in that vicinity. Between now and the first of the year the new power plant at Merced Falls will be completed and put into operation. During the year a dam has been constructed across the North Fork of the San Joaquin River at Power House No. 2 at a cost of about $22,000. Several other improvements have been made which has greatly increased the electric service in several irrigation districts.

TELEPHONE AND TELEGRAPH.

BLACKFOOT, IDAHO.—The Mountain States Telephone & Telegraph Company is extending its line into the country at a cost of $50,000.

LOS ANGELES, CAL.—The Home Telephone & Telegraph Company announces that $19,500, held as deposits by the company, will be refunded to subscribers through the application of the amounts upon current bills of the subscribers.

PHOENIX, ARIZ.—The Mountain States Telephone & Telegraph Company has sent a crew of men to Buckeye to rebuild the exchange at that point. A new central office will be built, new switchboard installed and the entire plant will be given a thorough overhauling. The work is under the supervision of District Wire Chief Anderson.

PORT ANGELES, WASH.—Permission to construct and maintain telegraph and telephone lines has been granted by the city council to the U. S. Weather Bureau, which is arranging for the purchase of the Western Union telegraph line from this city to Port Crescent.

BURBANK, CAL.—Application has been made to the trustees by the Pacific Telephone & Telegraph Company for a franchise to maintain poles, wires, etc., for telephone and telegraph purposes in this city. Sealed bids will be received up to January 15th for such a franchise.

GLOBE, ARIZ.—Officials of the Mountain States Telephone & Telegraph Company are making preparations for alterations in the local telephone system, which will cost not less than $28,000. Dean D. Clark of El Paso is division commercial superintendent of the company.

HARDIN, MONT.—The Sheridan Commercial Club has been asked by the Billings Chamber of Commerce to use its influence in inducing the Mountain States Telephone & Telegraph Company to construct a telephone line from Sheridan along the Burlington railroad right-of-way to Hardin.

TRANSPORTATION.

SAN BERNARDINO, CAL.—The Pacific Electric Railway has closed a contract for extending its line east from Palm avenue in Highland to the Clerghorn packing house.

RIVERSIDE, CAL.—A permit has been taken out by the Pacific Electric Railway for the erection of an interlocking tower on New Magnolia avenue at the crossing of its tracks with those of the Salt Lake line.

SAN FRANCISCO, CAL.—A petition to the board of supervisors, requesting that they further extend the Municipal Railways of this city by constructing a cross-town extension on 20th street between Potrero avenue and the new Church street line, is being circulated in the Mission district.

SAN DIEGO, CAL.—Permission to abandon its line on University boulevard between University and El Cajon avenues, has been asked of the council by the San Diego Electric Railway. The communication states that it is proposed to build a line on Park boulevard between University and El Cajon avenues.

LOS ANGELES, CAL.—An application has been filed with the city building department by the Pacific Electric Railway for a permit to build the proposed elevated service tracks extending east from the building at Sixth and Main streets to San Pedro street. The estimated cost is $166,000, and as soon as plans are checked up and the permit issued, work of construction will begin.

MODESTO, CAL.—That the plans of President Byron A. Bearce and officials of the Tidewater-Southern to extend its line from Modesto to Turlock have not been abandoned nor even suspended is shown by the activities of a force of men and teams now at work grading the roadbed west of Turlock. The work now in progress of grading the roadbed for the extension of the Tidewater electric line indicates that the route to be followed extends almost directly south after crossing the Tuolumne River to the Hatch ranch, six miles West of Turlock, thence directly east to Turlock.

SAN FRANCISCO, CAL.—Because of the United Railroads' opposition to the construction of the tracks on Market street for the Church Street Municipal Railway line, the city engineer has presented three propositions to the public utilities committee of the supervisors. One is to temporarily forego laying tracks on Market street from Church to Van Ness avenue, as originally planned, and to carry the Church street line across Market street to Hermann street, and thence along Buchanan and Oak streets to Van Ness avenue. The Church street cars are to run downtown on Geary street, according to this plan. The cost of this extension is estimated at $110,000. The next proposal is that an arrangement be made with the United Railroads for the use by the city of the company's tracks on Market street between Church and Van Ness avenue. His third suggestion is for operation of city cars on Church street from Thirtieth to Market and an exchange of transfers with the United Railroads at Market street. He also urges the supervisors to give attention immediately to the construction of a railroad through Twin Peaks tunnel.

WATERWORKS.

PHOENIX, ARIZ.—The city has awarded a contract for furnishing 198 meters and connections to the National Meter Company at the contract price of $1826.50.

PORTLAND, ORE.—Bids are being taken by the City Purchasing Agent, J. R. Wood, for furnishing the city of Portland with 250 water meters.

DALLAS, ORE.—A permit has been issued by the state water board to Falls City to divert water from Teal Creek just above Falls City for use by the city.

GRANTS PASS, ORE.—An ordinance providing for the submission of the question of voting bonds in the sum of $80,000 for the building of a new municipal water system, was defeated at a recent election of the council.

SEATTLE, WASH.—A resolution has been passed by the city council providing for the improvement of Twenty-fifth avenue by constructing therein water mains with all necessary appurtenances, according to plans prepared by the city engineer. A hearing will be held December 27.

WHITTIER, CAL.—Engineer F. C. Roberts of Los Angeles has been commissioned to prepare plans for a new water works and distributing system to be installed at Whittier at a cost of $100,000. A bond election will be called to vote bonds for the work.

SALEM, ORE.—Wesley B. Sherman's application for permission to appropriate sufficient water of the Rogue River at Hell's Gate to develop 2500 h.p. for irrigation and power purposes has been approved. The estimated cost of the works to be put in is $200,000.

MARTINEZ, CAL.—Engineers who have been investigating the water supply recently discovered on two ranches near this city have reported to the council that it is adequate. It is the intention of the council to call a bond election to provide $65,000 necessary to handle this project.

BREMERTON, WASH.—In the final hearing of the water purchase case and the issue of bonds by this city, held before Judge King Dykeman of King county, the city won the case. The bonds were voted August 3d, giving Bremerton the right to purchase the water plant of the Garrison-Fisher Company.

SAN FRANCISCO, CAL.—As the result of a request of the board of public service commissioners, the supervisors and members of the water board have reached an agreement as to the policy that shall govern the laying of a distributing system in the San Fernando Valley irrigating system, for which $2,604,000 of bonds have been voted. The supervisors will follow the usual course in advertising for bids.

BANDON, ORE.—The city council has voted to accept the bids of the Northwestern Bond & Mortgage Company of Portland on $40,000 in 6 per cent refunding bonds, and $40,000 in 5½ per cent water bonds of the city of Bandon. The bonus offered on both issues was at par plus accrued interest. The $40,000 bonds are half of the issue authorized at the city election in June for the improvement and extension of the water system.

LOS ANGELES, CAL.—There being no legal protests filed against the creation of Municipal District No. 1 in the Hollywood and East Hollywood section, the city council has instructed the city attorney to submit an ordinance calling a special election in the district on January 18, 1916, for voting on $1,000,000 waterworks bonds with which to purchase the Union Hollywood Water Company's system and make extensions and improvements.